SCIENTIFIC AMERICAN

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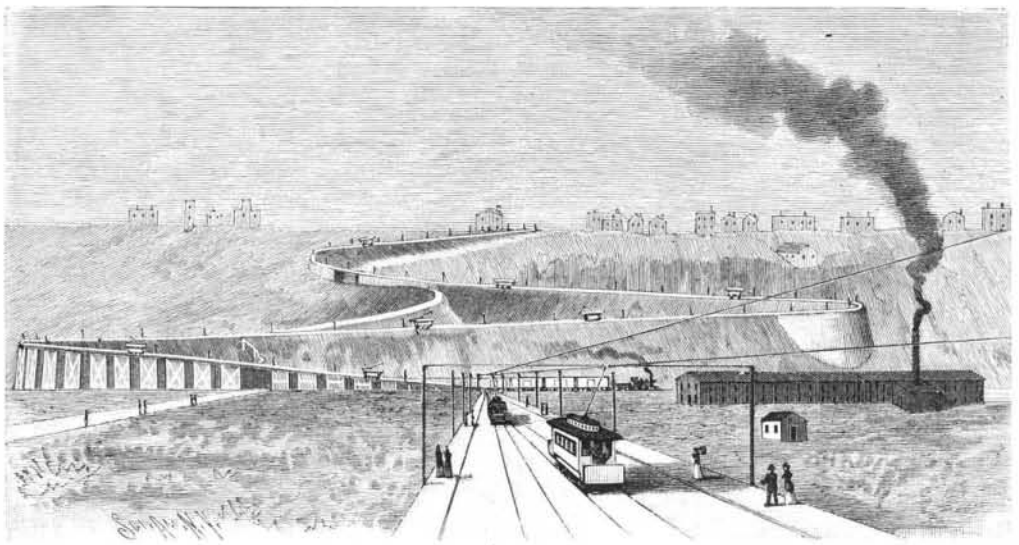
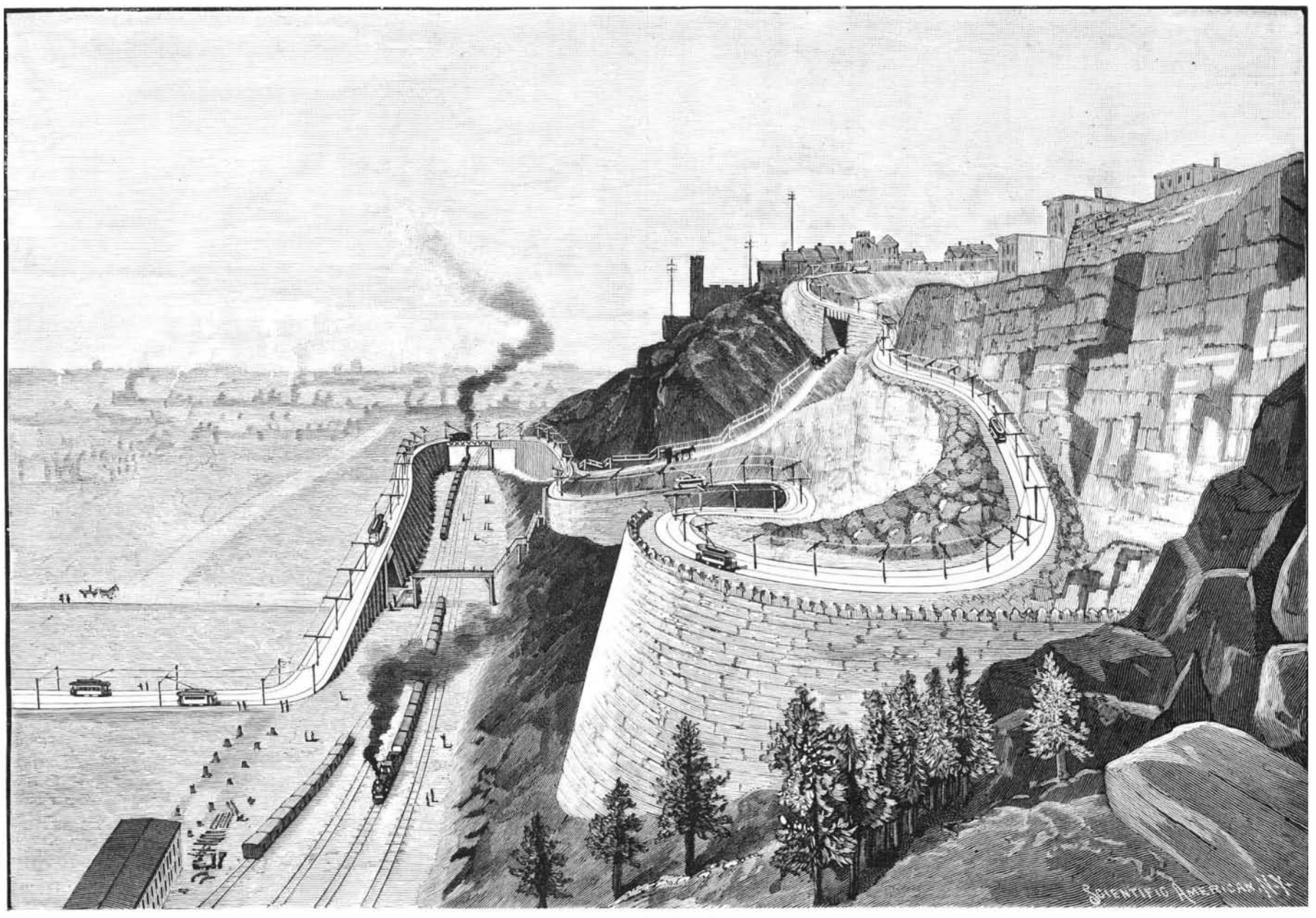
THE HILLSIDE LINE OF THE NORTH HUDSON COUNTY RAILWAY COMPANY.

The North Hudson County Railway Company is a corporation owning a number of miles of surface and elevated railroads in Hudson County, New Jersey, which extend in their operations from Jersey City to the northern line of the county. This part of the country is characterized by the beginning of the hill which eventually forms the basis of the Palisades. Between the river and the foot of the elevated ground is a large area of flat land. The North Hudson County Railway Company has to provide transportation from the ferries on the river side to the top of the hill, involving a rise in some cases of nearly 200 feet. There are three means of access to the hill top—one from Hoboken Ferry by elevated road operated by trolley; and another at the terminus of the West Shore ferries by elevator and elevated road. We illustrate in our present issue a third structure, by which the summit of the hill is reached by a trolley line, known as the Hillside Electric Road. The map and the two views show the general construction and line of the road, and its extreme picturesqueness, in addition to its engineering interest, will be obvious features not at all exaggerated in our illustration. The portion of the road which we illustrate commences at Madison Avenue and Fifteenth Street, at West Hoboken, a point nearly opposite Fifteenth Street in this city, and includes the interesting part, as from the ferry to this corner it is an ordinary surface trolley road. Here the ascent begins. By two loops it climbs the hill to Palisade Avenue, the horizontal distance in a straight line between these two points being 700 feet. By constructing the loops as shown a line 3,688 feet long is developed for the ascent of 160 feet. The rise begins with a wooden trestle running nearly parallel with and to the east of the railroad tracks of the New York, Lake Erie and Western Railroad and of the New Jersey Central Railroad, the cars as they ascend going almost directly south. A couple of blocks below is a curve of 90 degrees, with a radius of 75 feet, crossing the tracks of the railroads just mentioned on an iron truss. Going around another



GENERAL VIEW FROM FIFTEENTH STREET.

MAP.



VIEW LOOKING SOUTH.

THE HILLSIDE LOOPS OF THE NORTH HUDSON COUNTY RAILWAY COMPANY.

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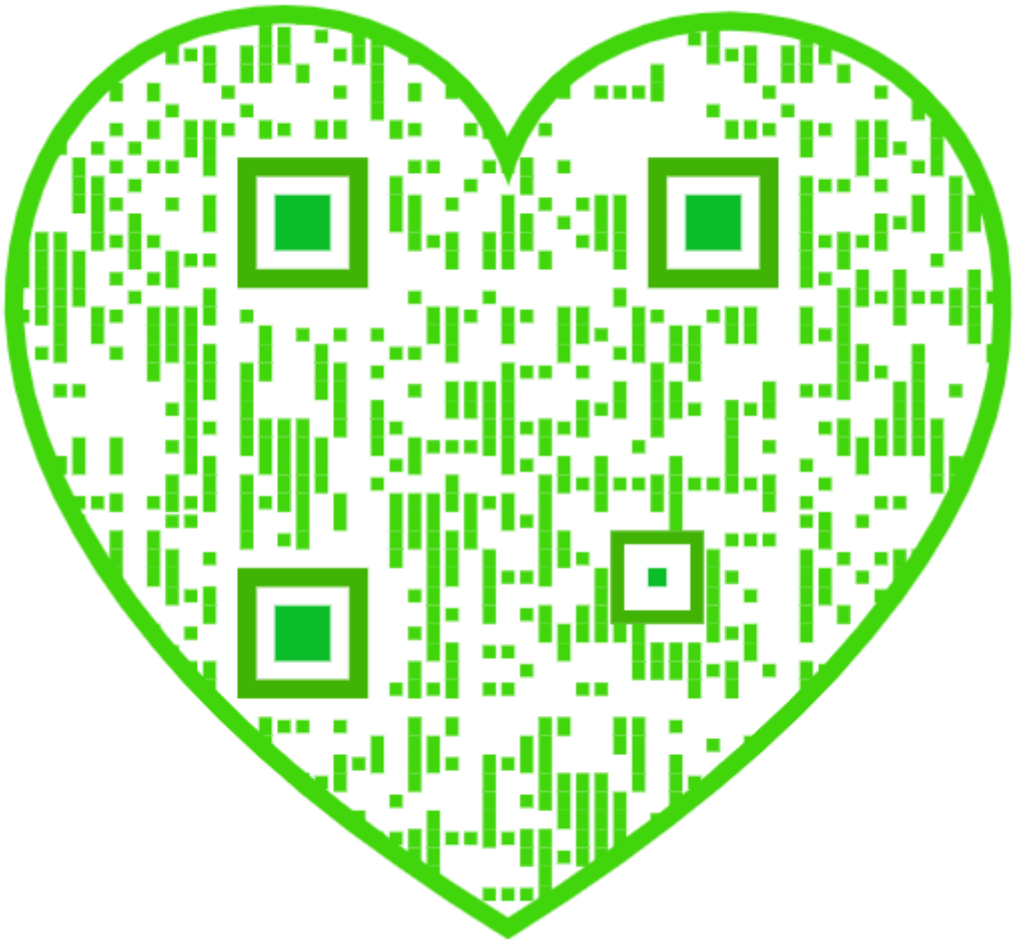

curve of similar radius and of 93° 58′, the road curves along the face of the hill, gradually rising and crossing the Hillside wagon road, which course on the ascent is now in a general direction to the north, until at an elevation of 110 ft. it enters the northern loop, and with a radius of 60 ft. goes around a curve of 215° 16′. The course is now to the southwest, and, still climbing the hill, the line crosses near the 140 foot contour line for a second time the Hillside wagon road, and going through an arc of 100° 32′ with 100 ft. radius, it reaches its destination 160 feet above its commencement and connects with the rest of the system.

The road is built in the most substantial manner, parts being cut out of the face of the hill, other parts being filled and substantial retaining walls being applied when necessary. One of the latter is 70 feet high. Stone ballasting is used throughout, the material of the hillside supplying the best possible material, trap rock, for these purposes. The railroad tracks are crossed by a 92 foot lattice girder, the most considerable bridge on the line. Fifty-six pound steel rails are used for the cars to run on, and these rails are re-enforced with 32 pound guard rails laid close to them and inside. The cost of the work was $120,000 for the structural part alone. It was built by Mr. Miles Tierney as contractor, with Mr. C. B. Brush as chief engineer. The surfacing and finishing of the road is done under the immediate direction of Mr. Wm. H. Starr, formerly of the Erie Railroad, who is now general manager of the road and in charge of its operation. Mr. Tierney is now president of the North Hudson County Railway Company.

The power for the Hillside line is supplied by a 14,000 h. p. compound Corliss engine in the power station of the Hudson Electric Company.

The route involves maximum grades of 51½ per cent, and on the curves a grade of 1½ per cent is not exceeded. The road is reached by the Fourteenth Street Ferry, directly from this city. On reaching the top of the hill the passenger is put in communication at once, by means of the other lines of the company, with all of the elevated area beginning at Jersey City Heights on the south and ending with Guttenburg on the north. The North Hudson County Railway Company operates about fifty miles of road, including twenty-four miles of horse railroad, nineteen miles of trolley and seven miles of steam railroad. A very complete system of interchanging makes the entire area accessible. The road carries about 17,000,000 passengers per annum.

The Consumption of Artificial Manures.

An estimate has been made in the *Journal* of the American Chemical Society of the world's annual consumption of these fertilizers, which is put at a total of 5,500,000 tons, made up of the following items:

	Tons.
United States	1,550,000
Germany	1,300,000
France	1,000,000
Great Britain	1,000,000
Belgium and Holland	300,000
Scandinavia	100,000
Spain, Italy, and Austria	250,000

These figures are, necessarily perhaps, only approximate, but with regard to the one million tons estimated for this country, it is discoverable from another source that the quantity of manures imported into the United Kingdom in the three years ended 1891 averaged 600,000 tons annually, so that a considerable quantity for home consumption must have been supplied within the kingdom itself, in the shape of waste from gas works and chemical manufactures. Among commercial manures would be included guanos, nitrate of soda, sulphate of ammonia, potash salts, basic slag, and other mineral phosphates, together with additional sources of phosphatic fertilizers.

A hope has long been cherished by English wheat growers that as the necessity for applying manures to North American lands becomes more pressing, the cost of wheat growing will have a prohibitive influence upon the export of the bread cereal to this country. Apart from the possibility that before such a time arrives the wheat-exporting capacity of Argentina, and even of South Africa, will have greatly developed, it will nevertheless surprise many people to learn that in the United States the consumption of artificial manures is already half as large again as it is in the United Kingdom. On the other hand, there cannot be much doubt that the quantity of farmyard manure put upon the land is, in an ordinary year, much less in the United States than in this country. It appears that the consumption of commercial manures has grown very rapidly in the last twenty years in the Atlantic, and especially in the South Atlantic States. Their use, moreover, is steadily on the increase in the Central and Gulf States, and they are gradually passing into consumption in the less remote and more thickly populated of the Western States.—*Chem. Tr. Journal.*

What Becomes of All the Lumber.

It is estimated that, of the general lumber product, 35 per cent goes into building, 45 per cent into railroads and miscellaneous uses, and 20 per cent into boxes.

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THE UTILIZATION OF THE WASTE ENERGY OF THE WORLD.

The solicitude displayed by the individuals of the human race of one generation for those of subsequent generations is a very variable quantity. Many who claim great enlightenment profess to regard the lot of the twentieth or the twenty-first century man with considerable solicitude, fearing that the consumption of accumulated stores of terrestrial energy by the present generation will result in leaving to our successors a very impoverished globe indeed for their habitation. It is assumed that a day will come when the wealth of fuel accumulated in preceding geological eras, and consolidated into usable shape by the metamorphoses of ages, will be exhausted, and mankind will be without fuel. By the best geologists this is regarded as no fancy sketch. Coal is not forming, the natural growth of wood is quite insufficient to supply the demand for fuel, and the coal mines will eventually be emptied.

Curiously enough, a parallel occurrence is now going on before us. But a few years ago the natural gas industry took great dimensions. The almost uncontrollable flow of gas from gas wells was the basis for the most extensive operations; gas and steel furnaces in the industrial world, street lamps, house service, both for fuel and illumination, were supplied by natural gas, and the entire gas region became the scene of a prodigality on nature's part never equaled in impressiveness. The general assumption was that the future might take care of itself; hardly a thought was given to economizing the supply, and it now appears as if that future has come upon us, for, in accordance with the predictions of one of our most eminent geologists, the end seems in sight. Natural gas in a very few years will be virtually a thing of the past.

It is an open question how long after the extensive application of the steam engine economy of fuel began to be considered. Certain it is that a comparatively early type of engine to-day is in use as one of the most economical. The Cornish engine has some very fine examples in the most modern practice. The early steamships were almost failures on account of their coal consumption, and steamship constructors, having a double inducement to save fuel, both to get rid of a non-paying cargo and to save coal bills, have done their utmost to effect economy. Hydraulic engineers have taken a professional pride in reducing coal consumption, the "duties" of the great pumping engines of the country being quoted far and wide.

Good work has been done, the steam engine being gradually brought, perhaps, as near perfection as its inherent defects will permit. But simultaneously with this the horse power of the world's engines is increasing, and coal is being burned in greater and greater quantities. It seems clear that natural sources of energy must in the near future assume a greater importance than they have hitherto. Electricity, whose powers are as apt to be overestimated by the public as underestimated by the professional world, will be an important factor in this. The operations at Niagara Falls will be an illustration of a return to the principles of olden times, with appliances of the day. For it is a striking fact that our forefathers utilized the powers of nature to a vastly greater scale proportionately than we do. The horse power hours of wind energy utilized by windmills and sailing vessels was proportionately great for the era before steam; to-day the aggregate is very large, but the proportional amount compared with steam is small. The farmers throughout the country a hundred years ago took their grain to grist mills driven generally by water power, sometimes by wind power. Modern improvement has replaced those sources of energy by steam—the future generation may yet have to return to them.

The amount of energy as far as we are concerned absolutely wasted in wind and tidal motions and in evaporation by the sun exceeds the imagination of man. Suppose a waterway such as Long Island Sound to be white with the sails of vessels. Each one utilizes a portion of the energy of the wind which its sails intercept. But remembering how high the wind prism may be, and comparing the sail area with the probable cross sectional area of the prism in question, the absolute insignificance of the proportion used in driving a fleet of ships may be realized.

The wind expends some of its energy in producing waves, which, besides making a sea voyage a misery to many, and besides foundering many a ship in open water, absolutely impede the progress of a vessel. But when we see these waves rising and lowering successively, wave after wave, a six or eight thousand ton mass, making it uselessly roll and pitch, the waste of energy exhibited by a million square miles of stormy water exceeds computation. The same applies to the tides. If the power of the tons of water that rise and fall forty to sixty feet in the Bay of Fundy could be utilized and distributed, it would replace a vast quantity of steam energy.

Electricity is often spoken of as a possible method of heating, but the fact is overlooked that the energy in almost all cases is originally produced at an enormous waste by the steam engine. But were it produced by natural causes, then this objection would disappear,

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and at once the possibility of electric heating is manifest. The dynamo of this day presents a very good method of changing the kinetic energies of nature, found in waterfalls, in the winds and in the tides, into heat energy. The trolley railroads exhibit the marvelous adaptability of electricity for the transmission of power.

Prof. Langley's recent investigations show that the air in motion possesses energy independent of its total flow, the variations in velocity affording a possible clew to an explanation of the soaring of birds. The earth is a center of enormous energies, of which an infinitesimal part only is utilized by man. With the exhaustion of coal will come about the necessity of utilizing some of these energies. The future man may eat a meal cooked by the tidal flow, may traverse the ocean in boats driven by wave engines, and may regard the steam engine as a relic of a semi-barbaric age —fully barbaric in its reckless waste of the accumulated riches of the past.

We need hardly worry ourselves about our posterity in a world without coal. The energies of nature are sufficient to do the work of mankind many times over, and possibly to form coal again out of the carbonic acid gas of the atmosphere. Electricity has already progressed far enough to give a hint at least of its future possibilities. It may yet be replaced by some more efficient agent for the transformation and transmission of energies.

Storage Battery Lighting and Car Propulsion.

In 1890 a train of cars on the Big Four Railway was equipped with the Silvey batteries [W. L. Silvey, of Dayton, Ohio], using twelve cells to each car and ten 16 c. p. 25 volt lamps. The light was first operated as an experiment during a run of 90,000 miles between Cincinnati and Dayton, Ohio. As a result, fifty-five cars were similarly equipped on the C. & O. R.R. running between Cincinnati and New York, and during three years no such thing as a short-circuited cell or buckled plate has ever occurred. The relative cost of the coal oil, Pintsch gas and Silvey storage battery incandescent light for the year 1893, after three years of constant use, is shown by the report of chief electrician W. S. Greene, of the C. & O. R.R., just published, to be as follows:

Electric light costs $17.73 per year per lamp; oil lights cost $24.12 per year per lamp; and Pintsch gas light costs $29.42 per year per gas burner or tip. The relative candle power of each light is as follows: Oil 10 candle power, gas 8 candle power, and electric light 16 candle power, showing that electric light by storage batteries cost 52 per cent less than oil and 69 per cent less than gas light of the same candle power.

The battery, after having been in daily use for more than three years, proving itself eminently successful under the ill treatment and hard usage to which all railway apparatus is necessarily subjected, Mr. Silvey turned his attention to the storage battery as applied to street car traction.

The American Car Company, of St. Louis, built one of its finest 16 foot car bodies specially for the work, provision being made for placing batteries in iron trays and sliding them under the seats through openings at the end of the car.

The motor with which this car is operated has an armature ring 3¾ inches wide by 24 inches diameter, wound with 2,000 turns of No. 14 B. & S. double insulated wire weighing about 40 pounds; the entire machine complete weighs 1,350 pounds and develops forty horse power. The entire equipment of motor, together with all gears, gear cases, etc., weighed less than 2,000 pounds.

The vital part of the system is the battery, as upon its proper performance the economy of the system largely depends. Low internal resistance must be assured before it is possible to operate without regulating devices, which in all cases are absorbers of energy, and, in a sense, more or less responsible for lack of economy.

The aim of the constructor of this battery has not been to push the efficiency of the apparatus to the utmost limit, making it very light in weight, but rather to make an apparatus capable of withstanding almost any amount of hard usage, and at the same time a battery that could be depended upon whenever needed, and one which if handled with any degree of care at all would always do its duty. It is believed that all this has been fully accomplished, inasmuch as, although the battery has been doing constant service operating the street car for the last nine months, no such thing as a short circuit or buckled plate in the cells has ever occurred from ny cause. Cells having a rated capacity of 30 amperes discharge have frequently been entirely discharged at the rate of 120 amperes and charged at the rate of 100 amperes without doing any harm, either in losing the active oxide or buckling the plates. These extreme charges are of frequent occurrence, as the batteries are charged in three hours and discharged every three and one-half hours during the day, two sets of batteries being employed, one operating the car while the other is being charged.

The battery plate proper consists of an inoxidizable alloyed lead grating, 5 by 7 inches square and about ⅛ inch thick, twenty-one of which constitute a complete battery cell. The perforations in the grid are filled with superficially oxidized particles of metallic lead and oxide of lead, after which they are subjected to a pickling process which hardens the fine particles into a firm coherent mass almost as hard as a rock, and by which it becomes firmly fixed into the holes and forms a surface layer over the entire plate. The plates are now taken and assembled in proper number to constitute a complete battery, there being one more negative than positive plate, as, for instance, eleven negative and ten positive battery plates. The plates are clamped together by means of a lead screw passing through the hole in the plate, nuts being placed between the plates and firmly screwed down, whereby good metallic contact is made, after which they are all welded on the surface and all soldering avoided. In case it ever becomes desirable to take the cell apart, it is easily done by removing these nuts, which by turning break the welded parts. The filling for the battery plates is chemically pure lead, and has been found in practice to give a useful working output of about 20 per cent greater efficiency than is possible with batteries employing a mechanically filled plate of lead oxide alone.

Between the sets of plates in the Silvey battery there is placed a sheet of a porous separating material, the edges of which are saturated with a preservative compound, and which has been treated with acids and alkalies until it becomes practically indestructible in the electrolyte and capable of absorbing about fifty times its own weight of the acids used in the battery. The latter, in fact, becomes nearly a dry cell, or in other words, there is very little free liquid to become spilled. Should the rubber cell ever become broken, the liquid held in suspension in the bibulous separating material is sufficient to operate the car properly during a trip.

In the operation of the car 108 cells of battery are employed, each cell weighing 27 pounds, making a total weight of batteries of about 3,000 pounds, which practice has demonstrated will, in everyday service, operate the car about thirty miles at each charge, running at full speed, which of course will exhaust the cells more rapidly than to run at more moderate speeds. In a test run made in November last the car made a round trip over the Third Street road in Dayton, Ohio, in 35 minutes, the distance being 9 miles. This included several complete stops, besides climbing two hills, each about 1,500 feet long and 4½ per cent grade, crossing 16 railroad tracks and a bridge 500 feet long, so that it is evident the car can easily make 20 to 25 miles an hour, if desired. The car has a controller on each platform containing a reversing switch and three complete changes of electrical circuits, by means of which three speeds of the car are produced.

The car, up to March 23, 1894, has made 6,200 car miles, and neither the batteries nor the motor have ever required a single cent for repairs; in fact, no additions have thus far been made to them except a new set of carbon brushes. The total expense of every kind has been $2.50, all of which was applied to the trucks. With such a record, which is believed to be without a parallel, it is thought that this system has no equal, and that a car can easily be operated at a cost not to exceed 8 cents per car mile.

The Colored American as a Soldier.

Rev. T. G. Steward, Chaplain 25th Infantry, U. S. A., in an article in the last number of the *United Service Magazine* says: Among the military matters coming regularly before the Fifty-second Congress was a proposition to reorganize the artillery and infantry arms of the service.

Had the changes sought in this proposition been secured, the field of the colored man in the army would have been considerably enlarged, and the number of colored men in the service thereby have been increased.

Hitherto there have been four regiments in the service—to wit, the Ninth and Tenth Cavalry and the Twenty-fourth and Twenty-fifth Infantry—of which, according to the law creating them, the enlisted men have been colored men. It is now proposed to confer authority on the President to direct, at his discretion, the enlistment of batteries of colored men to serve in any or all of the regiments of artillery as well.

This movement would indicate that the colored soldier, who won such favorable recognition during the closing period of the civil war, has been able to maintain the same honorable standing during the long period of exacting frontier service which has followed.

These colored regiments have passed all this time, with but little exception, in places far away from popular view, and amid dangers as great and hardships as severe as have been shared by any part of the army. In this dull and trying service they have been carefully weighed in the balances of usefulness, and the general testimony of those whose words are entitled to special weight is that they have not been found wanting. In encounters with robbers and Indians they have manifested both skill and bravery; so that out of ninety-three medals and certificates won for gallantry by the enlisted strength of the army up to 1892, twelve were won by colored men, which is one third more than their proportion.

Generally quite as hardy as white troops, their record in the surgeon-general's report for 1892 presents the two following noteworthy facts: The death rate among the white troops was 8·16 to the one thousand; among the colored troops, 7·11 to the one thousand. The admissions to the hospitals for alcoholism among white troops were 44·91 to the one thousand; among colored troops, 4·36 to the one thousand. Twelve years' experience by the Twenty-fifth Infantry, and a very hard winter's experience by the Tenth Cavalry, in the department of Dakota, prove beyond question that colored troops can stand the cold as well as other troops; and if well cared for, they are as well contented when the mercury is twenty or thirty below as when in "the land of cotton."

The Synthesis of Ammonia.

In June and November, 1893, Mr. P. R. Lambilly, of Nantes, patented a process for the production of ammonia by synthesis—a problem that has been pursued for a long time and the importance of which is classic. According to the *Moniteur de Quesneville*, the operation is effected as follows:

The process is based upon the reciprocal action of nitrogen, hydrogen, and aqueous vapor in the presence of substances that act by contact. It is characterized by the addition to the gaseous mixture of carbonic acid, which fixes the ammonia formed in the state of bicarbonate or formate.

As we know, ammonia, or hydrate of ammonium, has the property of forming salts with acids or the anhydrides of acids. It behaves in this case as an energetic base.

Through their formation from the elements, the bicarbonate and formate of ammonia disengage a quantity of heat that exceeds by more than 20 calories that which is produced by the union of the elements for the formation of hydrate of ammonium. According to Mr. Lambilly, this circumstance shows the advantage that may be derived from the direct preparation of these salts by means of free nitrogen. Such preparation, moreover, is realizable, since it suffices to produce the ammonia in the presence of oxide of carbon and carbonic acid or anhydrides of formic and carbonic acid. The reactions to be effected are the following:

$$Az + H^3 + CO^2 + H^2O = CO < \begin{matrix} OAz\ H^4 \\ OH \end{matrix}$$

$$Az + H^3 + CO^2 + H^2O = H\ CO^2\ Az\ H^4$$

Or else:

$$2Az + 8H + 2CO^2 + H^2O = CO < \begin{matrix} OAz\ H^4 \\ OH \end{matrix} \Big\} + H\,CO^2\,Az\,H^4$$

In fact, such reactions occur when the constituents, nitrogen, aqueous vapor, and water gas, of a mixture of hydrogen, CO and CO^2, are brought into contact with certain porous substances, such as pumice stone, charcoal, and boneblack, especially when they are platinized. They are produced even at a low temperature in the presence of spongy platinum or platinum black. They are more active, however, at temperatures near the points of dissociation of the salts, that is to say, toward 40–60° C. for the bicarbonate and 80–160° C. for the formate.

The gaseous mixtures pass into pipes filled with porous bodies heated to the temperatures indicated. Upon their entrance into the pipes they are saturated with aqueous vapor, either by the injection of a current of steam or by their passage into water heated to the proper temperature. Upon making their exit from the apparatus the gases pass into the water, wherein the ammoniacal salts formed dissolve. The gases that have not acted are collected and are sent back into the apparatus for a second time.

The solution of the salts is distilled over lime. If formate of ammonia is found therein, there is obtained, as an accessory product, formate of ammonia, which might serve for the preparation of formic acid or of salts.

It belongs to special industrial chemists to estimate the value of this process of synthetical fixation of nitrogen and to reduce it, outside of any pure scientific conception, to its just proportions.—*Le Genie Civil.*

Photographic Notes.

Eliminating the Yellow Color from Negatives.—A method outlined by Mr. A. Cowan at the London and Provincial Association, as reported in the *British Journal of Photography*, consists in first bleaching the negative with a weak solution of perchloride of iron and then in redeveloping with the ferrousoxalate developer. This changes the film to a dark black and produces any desired density. If the yellow color extends over the whole surface of the film, the plan does not answer as well, as a veil will redevelop.

Yellowness in dry plate negatives is due to insufficient fixing or insufficient washing after the negative has been fixed, and no remedy for it at all satisfactory has been devised. It cannot be removed by the ordinary clearing solutions recommended for eliminating pyro stains.

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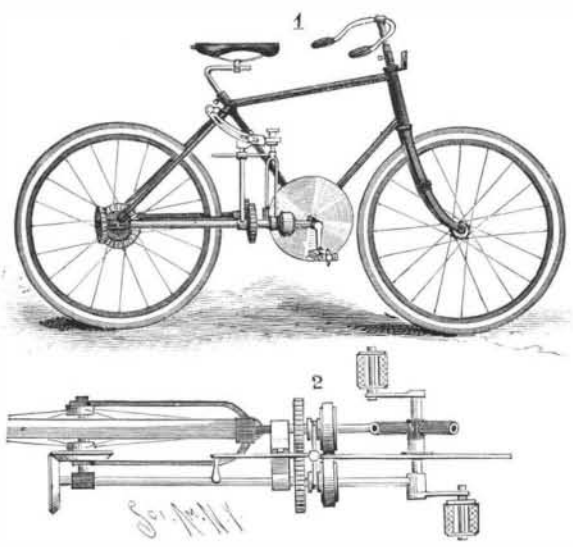
A VARIABLE DRIVING GEAR FOR BICYCLES.

The illustration shows a simple construction of variable driving mechanism by means of which a bicycle may be driven slowly with great power, as necessary in going up hill or over rough roads, or may be propelled with greatly increased speed, as is desirable on good and level roads, without changing the speed of the pedal shaft.



EISENHART'S VARIABLE DRIVING GEAR FOR BICYCLES.

The improvement has been patented by Mr. Samuel C. Eisenhart, of York, Pa., P. O. Box 72. Fig. 1 illustrates the application of the improvement to an ordinary safety bicycle; Fig. 2 being a plan view. On the pedal shaft is a friction disk whose sides may be covered with rubber, leather, or similar material, if desired, and this disk is engaged by friction rollers keyed to and sliding on horizontal shafts supported in ball bearings carried by the main frame.

The shafts are connected by meshing gear wheels, and the shaft on one side serves as a driving shaft, extending backward to the hub of the rear wheel, with which it connects by bevel gears.

The friction rollers have grooved hubs in which fit the prongs of a fork, whose upper end is coupled to a curved and longitudinally slotted plate having at its rear end a handle within easy reach of the rider.

The plate rides on a flanged guide roller held in the slot of the plate and fulcrumed at one side of the frame, and the fork is further guided and braced by a guide bar, which slides in a bearing or sleeve at the upper end of a post having feet journaled on the shafts which carry the friction rollers.

In propelling the machine, as the rider moves the friction rollers in toward the hub of the disk the speed diminishes, the reverse movement increasing the speed, the rollers being moved by grasping the handle and pushing the plate backward or forward as desired.

The invention also provides for a lighter form of driving gear in which only one friction roller is employed.

Milk Tickets as a Medium of Infection.

In an ordinance recently adopted by the council of Menominee, Mich., to regulate the selling of milk, a good point is made in giving protection against possible infection through the medium of milk tickets.

Section 11 provides that "No licensed milk dealer shall receive compensation in tickets from houses or premises which are placarded by the health officer until such placard has been removed, and all tickets found by such licensed milk dealer in such houses shall at once be destroyed by burning the same and new tickets issued in place of such as shall be found in infected houses. All milk tickets shall bear date of first use and be destroyed within three months."

What about soiled milk tickets or fouler money being left in the empty milk pails for the milkman?

This is in line with the action of the health authorities of Urbana, O. An order has been adopted prohibiting the use of theater tickets brought from some other city, the manager of each troupe being compelled to issue new tickets for the people of Urbana.

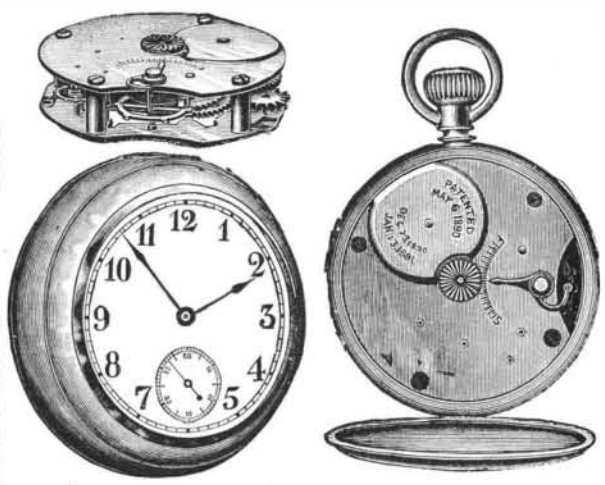
It is certainly well that every possible avenue of contagion should be guarded as closely as possible; but what is to be done with our dirty paper currency?—*American Analyst.*

The Mystery of Mind.

Mr. Lester Ward, in a lecture on the "Status of the Mind Problem," recently delivered before the Anthropological Society of Washington, showed that the work of Ramon y Cajal and others indicated that protoplasm is not merely the physical basis of life, but is the physical basis of mind also. In his words, "the prevailing fashion among scientific men of emphasizing the 'mystery of mind' is unnecessary and illogical, since mind is no more a mystery than matter, and all that there is any ground for confessing is that, in consequence of the greater complexity of mental phenomena, due to the higher state of development of the material basis of mind, we possess as yet much less knowledge of them than we do of many of the simpler phenomena of nature."

A LOW PRICED STEM WINDER.

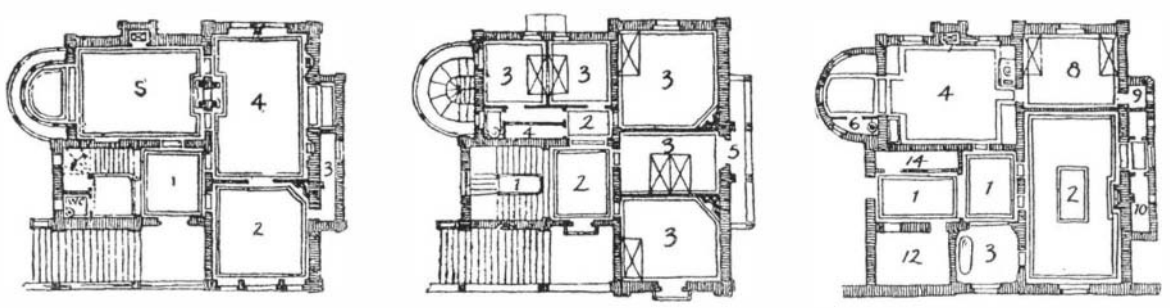
The watch shown in the accompanying cut has been selected to illustrate the extremely low cost at which the modern American watch, with all the latest improvements, may be produced. This watch is put on the market by Messrs. R. H. Ingersoll & Brother, of 65 Cortlandt Street, New York, at the extremely low price of $2. It is a stem winder, while the setting arrangement is shown in the cut in the center of the plate.

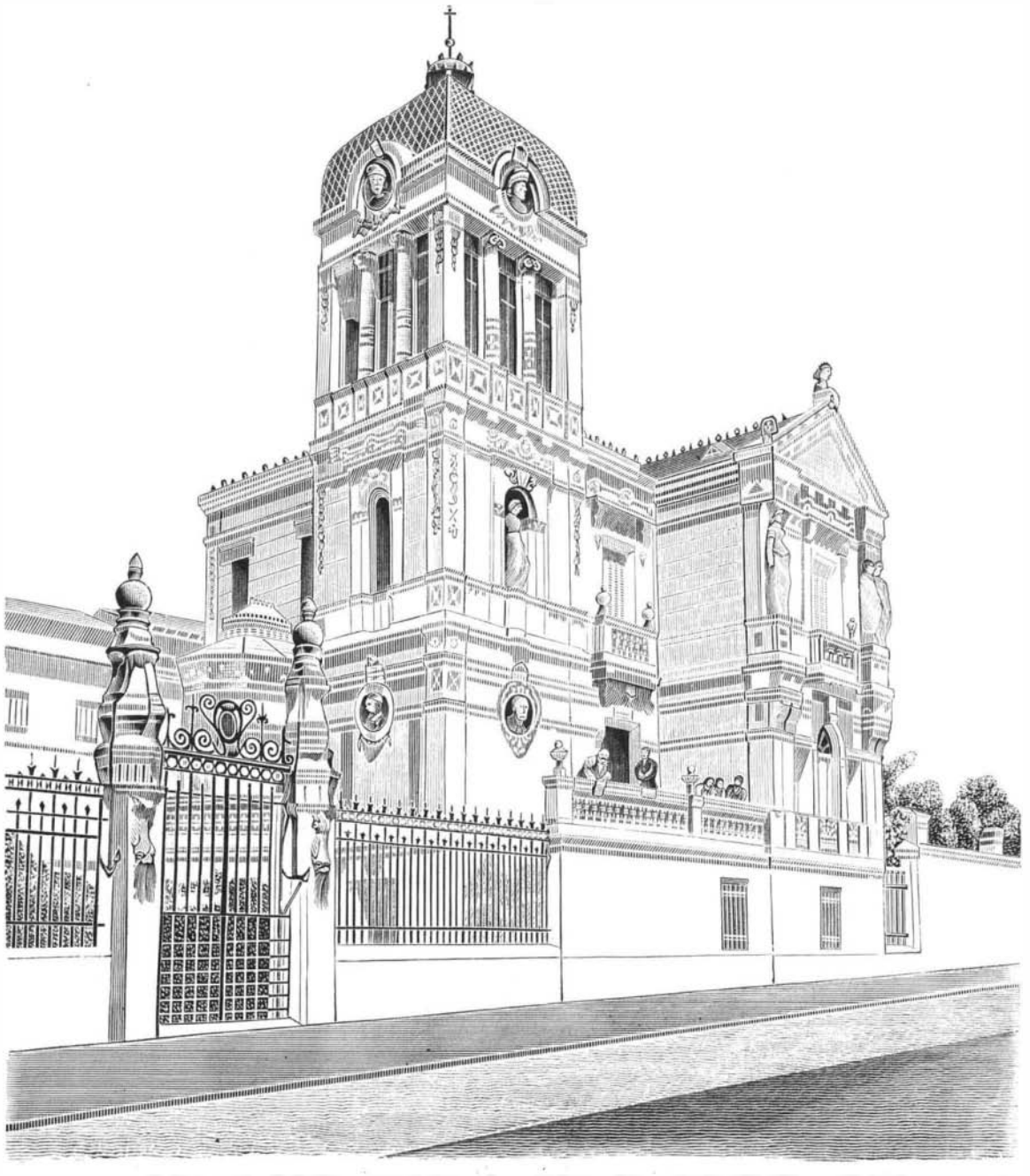


THE "CLIMAX" WATCH OF R. H. INGERSOLL & BROTHER.

The regulating device does not differ from that usually employed in high priced watches. The movement itself is a three-quarter plate, quick train, American lever movement. The short wind is one of the valuable features of the watch. The watch is extremely light, weighing only 3⅝ ounces, will run 30 hours with one winding, and is incased in a gilt or nickel case, plain or chased. A well made chain accompanies each watch. A general idea of the appearance of the watch may be obtained from our engravings, which are three-fourths actual size.

Over 1,400 watches are produced daily at this factory, or between two and three watches a minute, during working hours. It seems very extraordinary that a real watch can be produced, which is capable of regulation, so that it will keep excellent time, for such a small sum of money. The "Climax" watch is guaranteed to run satisfactorily to the purchaser for one year. It is a watch that ought to suit everybody.





HOUSE OF SENOR SARACIBAR, ARCHITECT, SALAMANCA, SPAIN.

HOUSE OF SENOR SARACIBAR, ARCHITECT, SALAMANCA, SPAIN.

A recent number of the *American Architect* contains a sketch and description of a newly erected house in Salamanca, which we here reproduce as an example of recent Spanish architecture in the line of private residences. Our cotemporary says:

In the broad and aristocratic district of Salamanca, and at the end of Claudio Coello Street, has been erected an elegant and artistic house, called "Villa Bilbao," which was designed for his own occupancy by Senor Julius de Saracibar, a well-known Spanish architect, who has passed the best part of his life erecting and embellishing the dwellings of many other persons, and has at last been able to construct his own, being able in it to display his genius and his skill as a constructor.

This residence occupies

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an area of about 8,000 square feet. It is difficult to distribute this space with more dexterity, for on this lot the villa has been built with an ample and marbled exterior *escalinata*, garden, small lake, grotto, kiosks, stables, departments for straw, a greenhouse and other accessories, all arranged so that nothing becomes a hindrance—everything is seen and everything is isolated.

In this abode, all the rooms are large, with high ceilings, profusely lighted and ventilated, with great economy of the land. The access to the property is from Claudio Coello Street, by a large and wide entrance between pillars decorated with allegorical details dedicated to the unconquerable city of Bilbao and to its famous siege.

The ground floor has its access at the level of the garden, but the floor is raised more than a meter above this level, profiting advantageously by the slope of the site and freeing the rooms from the humidity of the adjacent plantations; it contains the billiard room, bath room, kitchen, pantries, larders, lavatories and servants' rooms.

The first floor is approached by a commodious staircase, and from the exterior by the wide *escalinata* that we have already mentioned; this floor contains Senor Saracibar's studio, the large drawing room, the dining room, with a charming "rotunda" on the side of the garden, a hall and the beautiful staircase that goes to the second floor; in the latter are the bed and other rooms, all with direct light and with all the best conditions of sanitary and commodious arrangements; rooms for servants and for domestic services are provided in the roof, and a pleasant and isolated study room is at the top of the turret.

We will not fatigue our readers with an exact account of the magnificence and elegance of the ornamentation of these rooms. But we think it is our duty to attest that everything that is seen in this residence, from the ironwork of the doors to the carved furniture, from the curtain to the enormous chimney, the mosaic of the floors and the painted ceilings, everything has been made after the designs and under the direction of the proprietor, and everything shows the seal of the artist.

The pediment is crowned by a colossal head of the "Genius of Art." In the tympanum are sculptured the emblems of architecture, with branches of laurel and oak round them, and the heraldic shield of Senor Saracibar is suspended in a prominent place of the facade.

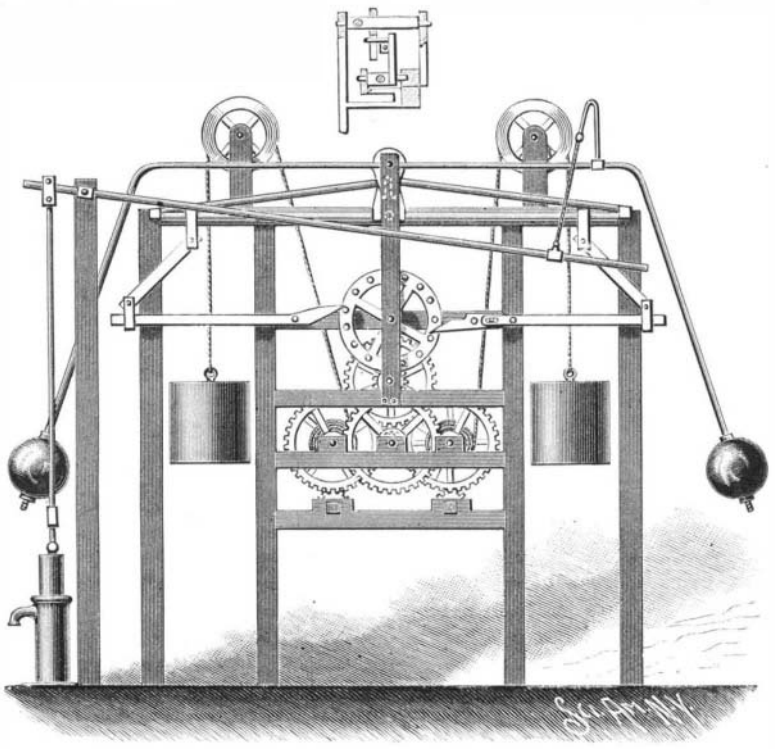
Forming part of this block of the building, follow at its left side and parallel to the public road other two blocks in the center of which is the entrance door, and above, on the same axis, a window; in front of the door there is a small terrace to which leads the broad *escalinata*, of which the balustrade is in the line of the street, adorned with openwork metal and vases in a very good taste.

The other block on the left side is formed by the square tower so characteristic in Spanish construction. There was in it a problem of no easy solution; in its large massiveness there were larger surfaces of the building that had to be decorated with sobriety, but in harmony with the rest of the work. A colossal bust and a statue have been enough to decide the difficulty with dexterity. The first is that of Michael Angelo Buonarotti and the second the Venus of the island of Melos.

The tower terminates in a belvedere, and in the middle of the cornice is a colossal bust of Apollo, the god who presides over the fine arts.

What is particularly worthy of notice in this house is the economy of the materials of construction and the employment of one very seldom used in Spain. The architect has striven to give the walls the precise thickness that may correspond to the necessary condition of stability and resistance, and where walls are suppressed he replaces them with iron columns or pilasters, properly spaced; this allows him to use thin walls, and to leave others open without complicating the construction; he abandons altogether all vertical wooden beams, and so economizes all the space he can.

The material is the "*sable mortier coloré*," made by M. Charles Stocker, Paris. It is an artificial stone of very good quality, that can be kneaded easily, and is furnished ground or in powder so that it can be moulded, the same as gypsum; it acquires later a great hardness. The walls are dressed with it, and mouldings, statues, adornments, and all sorts of high and low reliefs can also be made with it. Employing this stone mortar, it is unnecessary to paint the walls, and the color it acquires is more uniform than can be secured with any sort of stone. All the walls of the facades and all the work of sculpture of this villa have been made with it.



WHITAKER'S NEW WEIGHT MOTOR.

Artificial Marble.

M. Moreau produces an artificial marble from ordinary limestone in the following way: The stone is first carved into the required shape, and is then immersed in a bath of soap and a kind of varnish, which is floated on water and picked up by the stone. The stone is then immersed alternately in a bath of iron and copper sulphate, which permeates the body of the material, and when the absorption is complete the stone is immersed in hot water, which drives the coloring matter to the very heart of it. After this the stone is placed in a bath of zinc sulphate, and on being removed, after a few hours' immersion, is found to have the consistency and the specific gravity of marble. It is then dried in a warm chamber, after which it is ready for polishing.

WHITAKER'S NEW WEIGHT MOTOR.

The cut illustrates a clock-work mechanism designed to execute the heavier kinds of work, such as working pumps. The power is furnished by the two weights shown, one on each side, ropes from which are carried to and are wound around two drums, which form part of clock-work mechanism, with pallet wheel and escapement. Immediately below the wheels attached to the power drums are pinions with square-headed shafts, on which handles can be placed, and which are used to wind up the weights. The frame which carries the two pawls engaging the 'scape wheel is pivoted directly in a vertical line above the axle of the 'scape wheel, and as tooth after tooth of the wheel passes a pawl the frame rocks like the walking beam of a steam engine. Thus, as long as weights descend, the walking beam keeps up its motion. By an upwardly projecting arm, slotted, and attached to its axle, the motion of the walking beam is imparted to a bent pendulum rod, carrying pendulum bobs at its lower ends. As this rod swings back and forth, it moves, by a working arm, the pump brake, and operates the pump seen on the left side of the cut. Jerks and shocks are provided against by the use of a chain or other flexible connection between pump brake and pendulum rod.

This invention has been patented by Mr. Albert G. Whitaker, of La Porte, Ind.

UNDERGROUND CONDUCTORS FOR ELECTRIC STREET RAILWAYS.

The dangers and disfigurements occasioned by the overhead trolley wires, now so commonly used in this country, are well known. It is claimed by the managers of these railways that the overhead arrangement of the wires is necessary for the successful operation of the roads, and that no economical or practical system of underground conductors has yet been discovered. But this is far from the truth. There is no practical difficulty in placing the conductors underneath the track, where they are entirely out of the way and can do no harm. Roads thus provided can be worked with the same economy as the overhead trolley; the only difference is a somewhat increased first cost in the building of the road. But this is nothing when we consider the better security afforded to the public against loss of life and obstruction of the streets. The ugly telegraph and telephone poles are being removed from the streets in all our principal cities, and the time has now come to include the removal of the overhead trolley wires and their posts. One of the most successful examples of the underground electric system is seen in the operation of the Buda-Pest street railways, which ramify in all directions through that city. These railways have been in operation for several years, and their success, both from an electrical as well as financial point of view, is beyond question. We give an illustration of one of these lines, for which and the following particulars we are indebted to the *Railway World*. Considerable prominence has, perhaps deservedly, been given of late months to the system and details of the electric tramways operating in the capital of Hungary, and this for several reasons. In the first place, the Buda-Pest lines are, in respect of their permanent way design, quite unique, for there seems (at any rate in Europe) to be no other tramway that is operated successfully or practically by means of an underground conduit in which are placed the electric conductor wires. Secondly, the question of telephonic disturbance, due to electric tramways, has come prominently forward, and the Buda-Pest tramways have been cited as an example of the method most likely to give satisfaction to all parties concerned.

Yet another reason for the display of public interest in these lines may be given. As already noted in these pages, a prize of no small value has been offered by tramway authorities in the United States to the inventor or engineer who shall devise the best and most

THE BUDA-PEST ELECTRIC STREET RAILWAY.

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practicable substitute for the overhead conductor wire or "trolley" system of electric traction for street purposes. It is thereby doubtless thonght that an efficient plan will be developed for the use of underground conductors in a condnit; at any rate, the Buda-Pest lines are instanced in this connection as proving suitable for all practical reqnirements. What may in some respects be considered good proof of the latter statement is given by the fact that quite lately it has been decided to adapt all the remaining tramway lines in Buda-Pest for electric traction upon a system similar to that which is herein described.

The electric lines in Buda-Pest have been built and equipped by Messrs. Siemens & Halske during the past five years, along four of the principal tramway routes of the city. So far as the street surface is concerned, they do not show any striking difference from ordinary street tramways operated by horses. There are no poles, or span wires across the streets, from which the electric conductors are hung in the "trolley" system; nor is there a third rail, or a third grooved slot. There are simply two rails for each track, upon which run the car wheels as on ordinary lines, and these are not employed in any way as part of the electric circuit for conveying current. The latter travels to and from the motor cars along conductors in an underground conduit or channel made of concrete, and carried underneath the whole length of one rail of the track.

The interior of the conduit or channel is egg-shaped, 13 inches high and 11 inches wide in the clear; at distances of 1·2 meters apart (say 3 feet 10 inches), cast iron frames, of square shape, are embedded crossways in the concrete. These frames have ribs or flanges 7 inches broad, of a profile similar to the concrete channel, and they serve not only to strengthen the latter, but also as supports for the rails. Moreover, the conductors along which passes the current for the cars are fastened to these flanges through the medium of suitable insulators. The bottom of the interior channel is about 22½ inches below the level of the rails. The latter are from the well known Haarmann Works, and in section resemble two ordinary I or girder rails, with the inner flanges removed. They are secured to the iron cross frames of the conduit by means of wrought iron angles, the two rails being placed side by side along each edge of the slot or gap in the conduit. The width of slot, or distance thus left between the rails—for access to the conduit channel and conductors—measures $1\frac{5}{16}$ inches. This width has been chosen so as to allow the flanges of the wheels to pass easily around curves, and is the same as that used in ordinary rails. If the electrical connection only had to be considered, this width could have been materially reduced.

The current conductors of angle iron are led along the sides of the conduit channel, being fastened as already stated, to hollow insulators; one conductor serves as the lead, the other as the return. They both lie directly underneath the rails, and therefore cannot be seen or touched from above; and they are fixed sufficiently high above the channel bed to prevent contact with any water that may drain through, or lie in the channel. Sumps are provided at intervals to collect and retain such water and mud as may find access to the conduit, the overflow passing into the street sewers. There is no difficulty about this, nor any danger of water backing up from the sewers, as the base of the channel foundation does not exceed at any point a total depth of about 2 feet 4 inches from rail and street level. The second rail of each track might of course be of any desired section, since there is no conductor or conduit underneath. For instance, a flat rail could be used, and in such a case each track would have but one groove in the street surface—an undoubted advantage.

The cars do not outwardly present any different aspect to that of any ordinary street railway car; they have no drawbar arrangement at the ends, but on the top of each underframe sill is a buffer, which also serves to carry a coupling to allow of a trail car being attached. The car motor is placed in a closed casing between the two car axles; a system of double chain gear is employed to reduce the speed ratio, driving on to one of the car axles from the motor spindle. Quite lately, however, some of the cars have been equipped with single reduction gear, working direct from the motor spindle to one of the car axles. Under the end platforms of each car are placed four groups of resistances; by throwing these in or out any desired variation in the speed may be obtained. In practice, however, it is found quite sufficient to use two groups only. Regulation in this way is effected simply by means of turning a handle at either end of the car, according to the direction in which the latter moves; and the same handle, for that matter, serves to regulate the current through the motor, and change its direction of movement, thereby altering also that of the car.

The line potential is maintained at a pressure of 300 volts, and contact is made with the angle iron conductors in the underground channel by means of a traveling contact piece attached to each car. This is, of course, made of two metallic parts, one insulated from the other, and rubbing against the positive and negative conductors respectively.

There are employed 63 motor cars, 8 trail cars, and 9 large cars for the Friedhof steam line. The maximum speed is 9½ miles an hour; but a little more than this, about 11 miles, is reached in the suburban districts. On the narrower streets near the center of the city it is reduced to 6 miles; and at the crossings of important thoroughfares not more than 4 miles an hour is allowed. In consequence of the greater speeds thus attainable on the electric lines, as compared with horse cars, a very much larger daily car mileage can be kept up, with of course corresponding profits. Each car averages a run of from 75 to 100 miles per day of 16 hours.

Frozen Bottoms.

The *Agriculturist*, Summerside, Prince Edward Island, says: The dredging at Queen's Wharf here has disclosed a curious circumstance. Much of the bottom, where the dredging is being carried on, is frozen, there being about four inches of frost in some places 20 feet west of the wharf, and from 9 to 14 feet under the surface of the water. This has attracted the attention of a great many people, who are astonished to see great flakes of the frozen bottom brought up by the dredge. Different theories are advanced to account for this apparent impossibility, but the most plausible is that the frost follows down the timbering of the wharf until it strikes that part of the bottom adjoining the timbering, thence following the surface out quite a distance from the wharf. If any one doubts the truth of the above—which to some might seem like a particularly large sized fish story—he has only to visit the place when dredging is in progress, and obtain "ocular demonstration" of the fact set forth above.

[The dredging appears to have been in operation about the 1st of March or the latter part of the winter season, when the ocean water, circulating through the Northumberland Strait, may have been near its freezing temperature of 28° F. The current would carry this temperature by its change of 7 to 8 feet tidal height to a considerable depth—or to sweep along the mud bottom near the shore of Summerside. It is well known that fresh water in the land bordering on the sea shore moves toward the sea and permeates the soil beneath the salt water. In many places it appears as springs beneath the sea. The location of mud flats along a shore with fresh water percolating beneath would naturally saturate the mud with fresh water, which, by contact with the cold salt water during the winter season, would naturally become frozen to a small depth and remain frozen until the temperature of the salt water should rise above 32°. The phenomenon is probably not a local one, and may be found along the mud shores of any cold sea. The dredge only brought the fact to light in this case.—ED. S. A.]

The Synthesis of Sugar.

The attention of the French chemical and industrial world is at present attracted to a synthetical process of manufacturing sugar patented June 17, 1893, by Mr. Pellegrini, and the text of whose patent is published in the *Sucrerie Indigene et Coloniale* of February 6, 1894.

Chemists have been endeavoring for a long time to produce sugar directly, through synthesis, that is to say, by the combination of its simple elements. The Messrs. Thenard, father and son, were the first to make tentatives in this direction, but without success.

Mr. Maumene, upon submitting three gases—carbonic acid, ethylene and aqueous vapor—to the action of the convective electric discharge, obtained some substances of the sugar group, but the product contained no trace of ordinary sugar, or saccharose, the chemical formula of which is $C^{12}H^{22}O^{11}$. It was a mixture of various glucoses, which differ from saccharose in an additional molecule of water, and the formula of which is consequently $C^{12}H^{24}O^{12}$.

Mr. Fischer, a well known chemist, recently undertook some remarkable experiments upon the synthesis of sugars. Upon causing acrylic aldehyde, or acroleine, to undergo numerous substitutions and transformations, he obtained some glucoses, and, particularly, levulose having absolutely the properties of the levulose extracted from fruits or inverted sugar. But he was unable to succeed in ascending from levulose to the sugar of the cane or beet, since it was impossible for him to rid the levulose of the molecule of water, the elimination of which would have given common sugar as a result.

Ordinary sugar is, as we know, the product of the combination of three simple elements, carbon, oxygen and hydrogen, associated in the following proportions: 12 molecules of carbon, 22 of hydrogen and 11 of oxygen, whence its formula $C^{12}H^{22}O^{11}$. It is Mr. Pellegrini's opinion that, before uniting to form saccharose, the carbon, oxygen and hydrogen combine with each other in pairs, constituting carbonic acid (CO^2), ethylene (C^2H^4) and water (H^2O); that these three bodies then unite in the following proportions: 4 molecules of carbonic acid, 3 of ethylene and 3 of water; and that the result of the combination is saccharose. This explanation, it must be admitted, corresponds to the formula of ordinary sugar. We can, in fact, write the following chemical equation, which exactly translates Mr. Pellegrini's theory:

$$\underbrace{4\ CO^2}_{\text{4 carbonic acid.}} + \underbrace{4\ CH^4}_{\text{4 ethylene.}} + \underbrace{3\ H^2O}_{\text{3 aqueous vapor.}} = \underbrace{C^{12}H^{22}O^{11}}_{\text{sugar.}}$$

It will be understood that the three gases, carbonic acid, ethylene and aqueous vapor, are capable of combining in such a way as to produce sugar only under certain peculiar conditions. Mr. Maumene had recourse, unsuccessfully, to convective discharge of electricity; the Italian chemist utilizes the phenomenon of osmosis. Into an iron box divided into two compartments by a partition of pumice stone, boiled in a solution of chloride of platinum to increase its porosity, he introduces on one side a current of carbonic acid, and on the other a current of ethylene, while aqueous vapor is made to circulate in the apparatus intermittingly. The three gases traverse the pumice stone through osmosis and combine therein, and the product of the combination, under osmotic action, is a white sirup that it suffices to concentrate in order to obtain, as Mr. Pellegrini claims, pure sugar. Such, briefly, is the principle of the apparatus, which, according to the inventor, permits of effecting the synthesis of crystallizable sugar in starting from carbonic acid, ethylene and water.

As for the possibility of producing sugar by this process, it appears impracticable to several scientists who are familiar with theoretical speculations, on account of the schematic position attributed to sugar, and which is due to the decompositions that the latter undergoes in the presence of reagents. Chemistry, which, through theoretical considerations, has led to the synthesis of so many substances of an everyday industrial application, such as alizarine, indigo, etc., will certainly, after persevering efforts, succeed in producing sugar also, but whether the problem is practically soluble by the Pellegrini method remains yet to be seen.

Wooden Water Mains.

A recent paper read before the American Society of Civil Engineers by James D. Schuyler, member of the American Society of Civil Engineers, on "The Waterworks of Denver, Col.," contained some very interesting observations and figures relating to this subject. He states that sixteen miles of thirty inch wooden conduit were constructed in that work, in addition to a considerable length of forty-four inch pipe. The timber used was California redwood, and the thirty inch conduit was constructed to stand under a head of 185 feet. We understand from the paper named that the total average cost of the thirty inch pipe was $1.36 per lineal foot, of which about forty-eight cents constituted the cost of trenching and back filling. A gang of eight to sixteen men laid from 150 to 300 feet of the same size conduit per day. These mains were composed of staves dressed very smooth to cylindrical sides and radial edges, and were held to the cylindrical form by mild steel bands placed at a distance apart depending upon the head, but never exceeding seventeen inches. The pores of the wood are filled with the water under pressure, so that it oozes through to a slight extent, thus realizing the condition for permanent preservation. The pipe is framed in the trench, and all handling in full-sized sections is avoided; at the same time the interior finish is so smooth that the most advantageous conditions of flow are secured. Mr. Schuyler estimates that the use of these wooden conduits effected a saving of over $1,000,000 in this particular work.—*Fire and Water.*

New Atlantic Cable.

A new telegraph cable is now being laid from Waterville, Ireland, to Nova Scotia. The entire cable will be about 2,000 miles long. The Faraday, not being large enough to carry the whole cable, will drop the shore sections, about 500 miles, first, and then lay the deep sea cable, which is smaller than the shore ends. The cable is guaranteed to afford 33⅓ per cent improvement in speed over the other cables in use by the Commercial Company.

This will insure transmission at the rate of thirty words per minute. The cable is much larger than any ocean cable hitherto made. The Nova Scotia end has been provided with additional protecting armor to prevent its being broken by the anchors of fishing vessels.

Test of Projectiles.

At a recent government trial of projectiles at Indian Head, half ton missiles were fired from the 13 inch gun. The target was a 12 inch nickel steel plate, and two shells went entirely through it, one of them breaking to pieces and the other remaining intact after it had cleared the plate. The Carpenter shell was unhurt by the operation of rushing its half ton mass through a foot of solid steel. The 17 inch armor for the battle ships is yet to be tested.

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Correspondence.

The Galveston Jetties.

To the Editor of the Scientific American:

The SCIENTIFIC AMERICAN of January 27 has an interesting article on the four miles of jetty work at the mouth of the Columbian River, but its writer is mistaken in his statement that it is the longest jetty in the world. The south jetty, at the entrance of Galveston Harbor, is completed to the crest of the outer bar and is 32,000 feet long, which is a little over six miles of completed jetty, and there is 829 feet more uncompleted. (See annual report of Chief of Engineers for 1893, Appendix U.)

Galveston Bay, at the southern base of which lies Galveston Island, on the eastern end of which the city is situated, covers an area of about 400 square miles. Into this bay flow the Trinity and San Jacinto Rivers and numerous smaller tributaries. The ebb current discharging through Galveston Pass exceeds ten times that flowing through the South Pass jetties of the Mississippi. (*Vide* Col. Ernest, U.S. Engineer, before U.S. Senate Commerce Committee, January 30, 1890.) In its original condition this enormous discharge found vent into the Gulf over the wide unconfined stretch between Galveston Island and Bolivar Point. The general plan of improvement contemplated the compression with two rock walls of this giant force, to cause it to scour and carry to sea the sandbar which lay between the deep water inside the harbor and the deep blue water without.

The results thus far are the south jetty, extending eastwardly into the Gulf 32,829 feet, or over six miles; and the building of about two miles of the north jetty (work begun April, 1893) out from Bolivar Point, in its steady advance to a point opposite the sea end of the south jetty. When completed these two ends of the jetties will be about 7,000 feet apart.

The annual report of the Chief of Engineers for the fiscal year ending June 30, 1893, showed a navigable channel over the inner bar of 23 feet, an increase of 2 feet in twelve months, and a channel depth of 14 feet at mean low tide, an increase of three-fourths of a foot since June 30, 1892. The bar pilots report the constant and easy passage of vessels over the outer bar drawing 15 to 15½ feet, and a depth of 16 feet or more in ordinary high tides is not infrequent—an increase of a foot or more in twelve months, for actual use.

A glance at the construction of the jetties shows their substantial character. On a base of about 60 feet they rise to a height of about 5 feet above mean low tide—a riprap sandstone core, with a covering of immense granite blocks, which the heaviest wave action cannot disturb. Once inside the Galveston bar, there is a harbor sufficient in depth and area to float safely the navies of the world.

A commission of government engineers examined all the harbors on the Texas coast and reported that Galveston afforded the only possible port for 30 feet of water. This was based on the volume of water at ebb flow and the area of Galveston Bay affording a volume of water for scour not found at any other Gulf port.

Thirty feet is necessary for war ships of the government, and if the jetties do not give it by scour the contract for the jetties requires dredging. So far as the work has progressed it is so satisfactory that dredging has not been resorted to. For commercial purposes, 18 to 20 feet of water is adequate, and there is every prospect of that depth by the fall of 1894.

The work is done by contract, the sandstone carried by cars on track piled in advance of the work; the large granite blocks are swung in place by derricks from barges. The work was in charge of Major Chas. J. Allen, Corps of Engineers, to February 8, 1893, and of Major A. M. Miller, Corps of Engineers, since March 21, 1893, with Lieut. Wm. C. Langfitt, Corps of Engineers, from February 8 to March 21, 1893, Division Engineer Col. C. B. Comstock, Corps of Engineers. The estimated cost of the work in progress is $6,200,000, and has been let by contract. This contract is a War Department matter, to avoid possibility of delay; the money to pay for the work is not a River and Harbor appropriation, but an item in War Department work. The government has no 30 foot harbor on the coast and must have one at Galveston, the only possible point, and must have it as soon as possible.

The figures given as to work done and increased depth are all taken from the report of E. M. Hartrick, assistant engineer, made to Major A. M. Miller, June 30, 1893, at the end of the last fiscal year. The work and its results since then have made fine progress.

The normal tide at Galveston is about 18 inches on flood, as there is for practical purposes about an average of 15 feet to 15 feet 6 inches of water on outer bar, the government reports being based on mean low tide. When the work commenced there was only 13 feet on the inner bar. The last government report of June 30, 1893, shows 23 feet.

C. H. MCMASTER,
H. B. CULLUM,
GEO. E. MANN,
Committee of Chamber of Commerce of Galveston.

Galveston, Texas, March 27, 1894.

The Gegenschein or Zodiacal Counter Glow.

BY E. E. BARNARD.

In the first half of the century a German astronomer, Brorsen by name, in watching the face of the sky on moonless nights, noticed a large feeble glow of very diffused light in the midnight sky. This feeble light was from 10° to 15° in diameter. He soon found after a few observations that the object was moving nightly toward the east among the stars. A series of naked-eye observations soon showed him also that it was not only moving easterly among the stars, but that it was exactly opposite the sun and always remained so, and that its center lay exactly in the ecliptic. So exactly did it move with and in opposition to the sun, that if an imaginary line were passed from the sun through the center of the earth and prolonged to the sky, it would always pass through the center of this queer object. This fact being established, suggested to the Germans a name for it; they accordingly called it the Gegenschein—a combination of two words, *gegen*, opposite, and *schein*, light, meaning a light in opposition.

It seems after this for a time to have been neglected, if not almost forgotten.

In 1871, however, it was again independently discovered by Mr. T. W. Backhouse at Sunderland, England, who secured observations that confirmed its opposition to the sun. But even this second discovery did not attract attention to it as it should have done, and many people still doubted its existence.

In 1883, about October 1, the writer in seeking comets at Nashville, Tennessee, one night happening to look up to rest his eyes, saw a faint hazy glow near the constellation of Pegasus. This was thought to be a bit local haze, though it seemed abnormally permanent. The next night it was seen again and was therefore no ordinary haze. A few nights' location of its position showed that it was moving along the ecliptic eastward about one degree a day. Could it be an immense comet? It was certainly no ordinary meteorological phenomenon. The positions obtained were sent to an eminent astronomer with the suggestion that it might be some extraordinary kind of comet. He wrote back that I had discovered the Gegenschein.

Since then I have been very much interested in the object and have made numerous observations of its position. From these observations some new facts have been developed concerning this remarkable phenomenon.

I have said that this object defies the power of the telescope; this is true. From its great size and diffuse nature no telescope can grapple with it, its feeble light being destroyed by the power of the instrument and the want of contrast—the largest field being vastly smaller than the Gegenschein. Though it cannot be seen with any telescope, it is nevertheless a decidedly noticeable object with the naked eye when you know where to look for it.

Just what this mysterious light is no one has yet been able to satisfactorily explain.

Professor Arthur Searle, of the Harvard College observatory, has made an extensive study of the Gegenschein and is inclined to believe it due to an infinite number of small asteroids.

Between the orbits of Mars and Jupiter are known to be no less than four hundred small planetary bodies It is probable there are thousands and possibly millions more of these dust worlds. The smaller ones found in recent years are perhaps not over 10 or 15 miles in diameter. As they decrease in size doubtless they multiply in number, until finally they exist in untold multitudes of a size comparable with small stones and particles of dust, which no telescope will show individually. Each one of these small bodies is a miniature planet and must shine as a planet by reflecting the light of the sun. It therefore must present to us phases just as Mars does, but from the smallness of the objects we cannot see these phases—but none the less they must have an effect on the brightness of each little asteroid, and must diminish its light accordingly.

Let us assume there are a sufficient number of these tiny planets; though they may be too small to be seen individually in a telescope, yet their combined light may be so great as to affect the eye, and thus we might expect to see a feeble zone of light extending across the sky and corresponding to the asteroidal zone. Such we actually have in the zodiacal band. What would be the effect of phase of these individually small bodies upon the appearance of this zone of light? When opposite the sun each of the objects would shine with full enlightened disk, and this vast collection of fully illuminated particles would augment the light of the zone and give a greater luminosity immediately opposite the sun. Away from opposition, and the phase would begin to diminish the quantity of illumination. To this must also be added the fact that at opposition each asteroid would be nearer us and brighter from this cause also. Both causes tending to give a maximum of light opposite the sun—a Gegenschein.

This theory certainly appears very plausible, but there are objections to it.

There is one thing certain, if the Gegenschein is not really an atmospheric phenomenon—and everything except the fact of its existence seems to go against this supposition—it is at a considerable distance from us. Careful observations have shown no evidence of parallax. Of course observations of such an indefinite object cannot be made with anything approaching to accuracy, but if it were at no greater distance than 100 000 miles, its parallax would have shown in the observations.

That a satisfactory explanation of this most singular phenomenon will be arrived at when it has been sufficiently observed there is no doubt. Therefore it is very desirable that as many careful observations of its position and descriptions of its appearance as possible should be obtained.

Here is a field which offers a splendid opportunity for amateurs to do new and valuable work where no instrument whatever is needed— nor indeed can be used. All that is required is a star chart and an approximate knowledge of the time—to within an hour or so. The observer will find much to interest him in watching this—one might almost say—uncanny thing as it circles the sky with its slow and measured pace.

The Gegenschein is best seen in September and October when it is passing from Sagittarius to Pisces. It is then a large and roundish glow, some 15° or 20° in diameter.—*Popular Astronomy.*

The Phonograph as a Witness in a Nuisance Suit.

In the Chancery Division, London, Mr. Justice Stirling had this case before him. The action was brought by certain occupiers and leaseholders in Manchester Street, Manchester Square, where one of the company's central stations is erected, to obtain an injunction against the defendants on the ground of a nuisance caused by vibration. Mr. Graham Hastings, Q.C., and Mr. Beaumont appeared for the plaintiffs, while Sir R. Webster, Q.C., Mr. Phipson Beale. Q.C., and Mr. Vernon Smith, represented the defendants.

Mr. Graham Hastings, in opening the case, said the object of the injunction sought for was to prevent the continuance of the nuisance created by the defendant's works. The nuisance was so material that the vibration consequent upon it made it intolerable to the occupants of the houses, or some of them, to dwell there. It seemed to be a most mysterious thing. Sometimes the vibration affected the top of the house, sometimes the bottom. According to the view of one gentleman, it arose from the fact that that part of the city of London was built on the bed of the river which once flowed over the locality, and the soil was of that character that it conveyed the vibration produced by the engines. It was said that this could be got rid of, but the learned counsel contended otherwise. The real defense, he contended, was that they had been doing all they could to abate the nuisance. Mr. Hastings proceeded to dilate upon the effects of the nuisance complained of, and quoted instances where families were shaken in their beds, and prevented from sleeping, clocks stopped, and to touch certain objects in the house caused the fingers to tingle, and alarmed the residents.

Prof. Silvanus Thompson, in giving evidence, produced a phonograph, which was placed on the bench before his lordship to give a repetition of the vibration and jarring caused by the working of the defendants' machinery in premises adjoining Marylebone Station. The phonograph had been set in various rooms in the houses affected, and witness produced it in support of his statement of the results of his examination of them. On the instrument being put in position on the ledge of the witness box, his lordship quitted his seat, and, walking to the end of his "bench," held the tubes to his ears. Apparently satisfied, his lordship, after listening for a minute or two, returned to his seat and made, as usual, a short note of the "evidence."

Some New Dyes.

In a record of some new tinctorial products found in the *Moniteur Scientifique*, it is interesting to note the progress—at least the holophrastic progress—making in the nomenclature of the materials that industrial chemists are producing for the use of the dyer, and of the chemicals that serve for preparing the same. Thus we find that, under the name of metacyanotetramethylediamidotriphenylecarbinol, the Farbwerke, of Haecht-am-Main, have patented a yellow coloring material, while Messrs. Dahl & Co., of Barmen, have taken out a patent for a blue dye derived from tetraphenyletetramidodinaphtylemethane and for a substantive trisazoic blue-black dye derived from amidobenzolazonaphtylamine and naphtylenediaminesulphonic acid. The subject of a patent obtained by Dr. E. Bottiger, of Dresden, is a process of preparing acetylamidodiethylepyrocatechine. Finally, on account of its apparent simplicity, may be mentioned a process of preparing colors from triphenylemethane, invented and patented by Messrs. Cassella & Co., of Frankfurt-am-Main. It consists merely in oxidizing together dimethyle (or di-ethyle) dibenzylediamidodiphenylemethanedisulphonic, dimethyle (or di-ethyle) benzylethylediamidodiphenylemethanemonosulphonic and diethyledibenzylediamidodiphenylemethanemonosulphonic acids with diphenylamine, methylediphenylamine, ethyle diphenylamine, and m-methoxy- (or m-ethoxy) diphenylamine.

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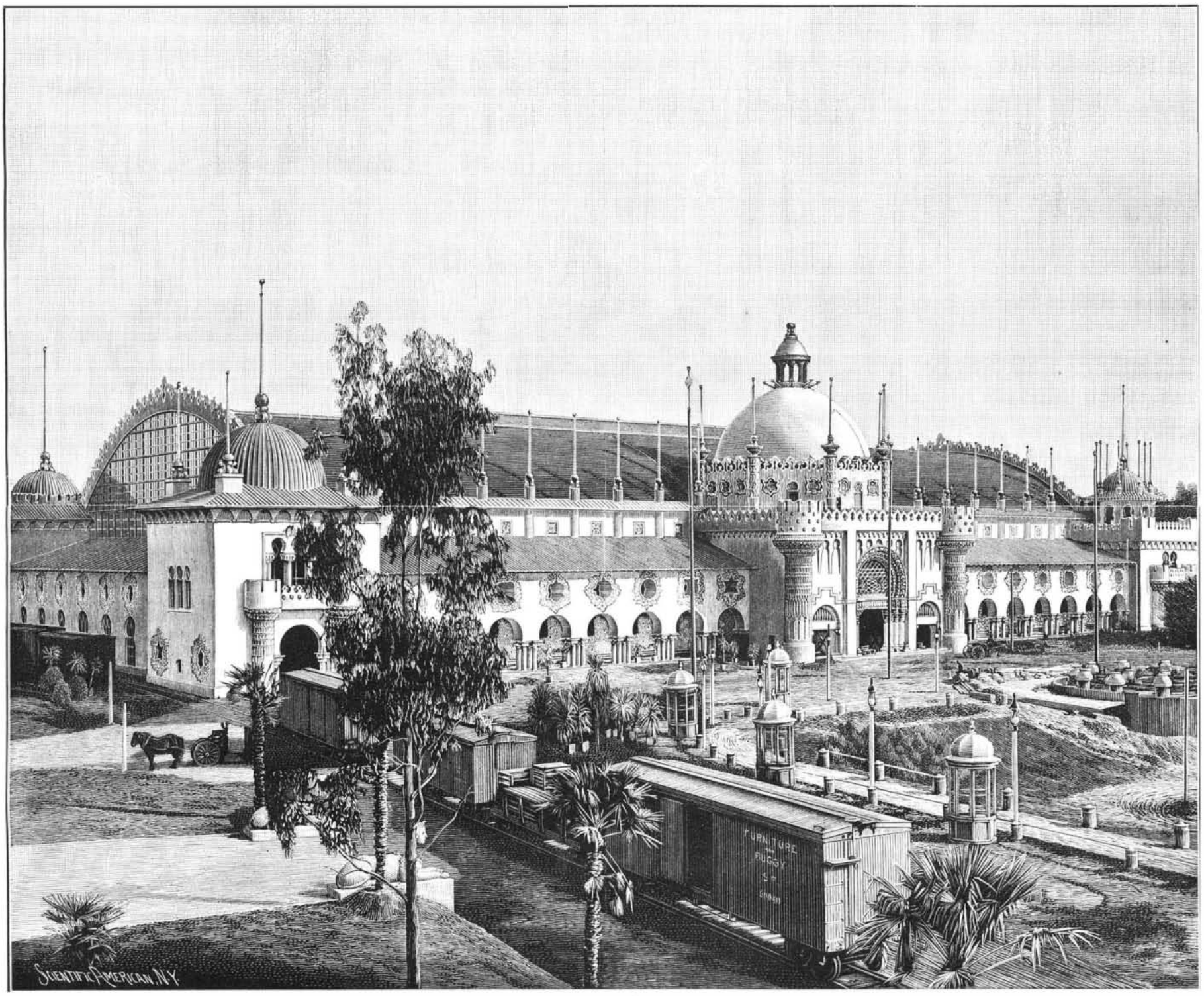
Corrosion of Pipes and Telephone Cables Due to Electrolytic Action.

Since the introduction of the trolley electric system, considerable has been said and written concerning the subject of corrosion of pipes, etc., by the return current of electricity used in operating the roads. The subject is a very serious one, when you consider the extent of damage done the water pipes, gas pipes and telephone cables by electrolytic action. The trouble lies in inability of the return circuit to carry back to the dynamo the current discharged through the car wheels. There are several systems used in operating trolleys, the most prominent of which is the single trolley system, where but one overhead wire is used for each track. More than 75 per cent of the roads operated in this way use the overhead wire for carrying the positive or outgoing current; but Mr. J. H. Vail, who is an authority on such subjects, in a paper read before the annual convention of the National Electric Light Association in Washington, D. C., last month, says: "The track system of all electric railways should really be the positive side or outgoing circuit. It will be readily understood that as the current travels from positive to negative, therefore any arc which occurs between the trolley wheel and the trolley wire will carry metal from the trolley wheel and deposit it on the trolley wire. If the reverse method of connection is made, the trolley wire will lose the metal, which will be deposited on the trolley wheel, and in time the strength and conductivity of the wire must be seriously impaired, eventually resulting in breakages." Some time ago a road in Boston changed from the former to the latter system for experimental purposes, finally deciding in favor of the overhead wire for the positive current. One year was devoted to each system.

In the positive overhead wire system the rails should act as a continuous conductor for carrying the discharged electricity back to the dynamo; but they fail, owing to improper connections at the rail joints. Leakages occur at these points even when a very heavy copper bond is used. Earth, especially when it becomes damp, acts as a conductor; consequently, when a leakage occurs at a rail joint, the electric current immediately takes to the ground, and the earth in the vicinity becomes charged with the current which was designed for the rails, and plays to a considerable extent the part of a return wire. Iron or lead pipes (which are better conductors than the earth) extending along the route below the surface become charged. This condition involves a discharge at some point, and here the electrolytic action is established, which, little by little, carries away the metal, or rather converts it into a compound which, in the moist earth, is readily detached. When this action is confined to a limited area, as at an abrupt bend in the pipes, the corrosion is rapid; but when it is distributed along a stretch of several hundred feet the destructive action is slower, but nevertheless constant and sure. Of course in some places electrolysis is more rapid than in others, owing to difference in the chemical composition of the earth. Several plans for correcting this evil have been tried, the best results so far obtained being from electrically welding the rails in sections of about two thousand feet. Rails of a new line soon to be constructed in the southern part of Brooklyn, N. Y., will be laid on this plan.—*Railroad Gazette.*

THE MIDWINTER FAIR.

The idea that was kept steadfastly in view in designing the buildings and in laying out the grounds of the Midwinter Fair was to obtain picturesqueness. The well macadamized highways wind in and out, flanked by pretty little Swiss chalets, kiosks, or State buildings. This seeming haphazard arrangement is really a triumph of art, and is a radical departure from the somewhat stiff and formal arrangement of the White City. The Midwinter Fair at no point resembles the dreary, sun-scorched, shadeless avenue of concessionaires—the Midway Plaisance. Of course, the Fair requires some large open space to admit of an effective architectural grouping of the larger buildings. This is afforded by the Grand Court, which replaces the world-famed Court of Honor at the late Columbian Exposition. In the center of the court is a rich growth of grass, which is separated from the buildings by a road sixty feet wide. On the inner side of the road is a row of vases bearing palms and other exotic plants.



THE MIDWINTER FAIR, CALIFORNIA—THE MANUFACTURES AND LIBERAL ARTS BUILDING.

The decorative effect of the Grand Court is heightened by fountains, statues, and a series of highly colored Venetian masts. When the search lights bring out the gorgeous colors of the brilliant hued domes and minarets, the effect is superb and beggars description.

Probably the first building to attract the eye on entering the Grand Court is the Manufactures and Liberal Arts building, so named from the huge prototype at the Columbian Exposition. The great blue dome and golden lantern glistens against the intense blue of the semitropical sky like an immense jewel, while a peculiar suggestion of age is given by the grayish-green tiles of the roof. This building is the largest structure at the Fair. The architect was Mr. A. Page Brown, and the style adopted is Moorish. The building is situated at the eastern end of the Grand Court and faces the Administration building. The main portion of the Manufactures building measures 462 by 225 feet, while the annex is 370 feet long by 60 feet wide, so that with a gallery in the main building, 35 feet wide, the total floor space is 177,000 square feet. Under the dome there is an additional floor, 54 feet from the

M. Jablochkoff.

A dispatch from St. Petersburg states that M. Paul Jablochkoff died April 5 at Saratoff. M. Jablochkoff, who was an officer in the Russian army, invented in 1876 one of the earliest successful electric lights. The invention, which was known as the Jablochkoff candle, attracted great attention at that time, and in 1877 it was used quite extensively in Paris for lighting stores and streets, but has since been superseded by the more economical arc light. In brief the invention consisted in placing two carbon pencils side by side insulated from each other by some substance which is non-conducting at ordinary temperatures but which will, when fused by the intense heat of the current, become a conductor of electricity. The substance usually used was plaster of Paris, which gives a faint rose color to the light.

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ground, devoted to a roof garden. The span of the main trusses is 158 feet. The roof which they support is 92 feet from the ground.

The main entrance is surmounted by a dome, 46 feet in diameter and 132 feet high. On each corner of the main building is a pavilion or tower, 50 feet square, covered by a dome. The roof is covered with Spanish metal tiles and glass. The building is surmounted with a series of flagstaffs, bearing national standards and coats of arms of the various States. The total cost of the building, which is constructed of wood, iron, glass, and staff, was $120,000.

The decoration is in bright colors, but the effect is not so garish as might be expected, and the building is withal very pleasing, and adds to the Oriental effect of the whole.

In this great building thirty-eight nations have exhibits, so that the Fair can really lay claim to being a true international exhibition. The United States is well represented, while California is, of course, in the lead with her manufactures and the exhibition of her wonderful resources.

Pilgrims from the remotest corners of the West coast flock to San Francisco to behold the wonders of the great Fair. Among them are many of the pioneer settlers, who for years have been hidden away in quiet hamlets, seldom emerging from their retreats, and knowing but little of the wonderful growth and doings of modern civilization. The awe and astonishment of these good people on arriving at the Fair is well expressed in one of the photographic groups we herewith present.

JUST ARRIVED AT THE FAIR.

IMPROVED HIGH PRESSURE AIR COMPRESSORS.

The air compressor which we illustrate is one of a type introduced and constructed by Messrs. Elwell Fils, of Paris. We are indebted to the *Engineer*, London, for our illustration and the following particulars:

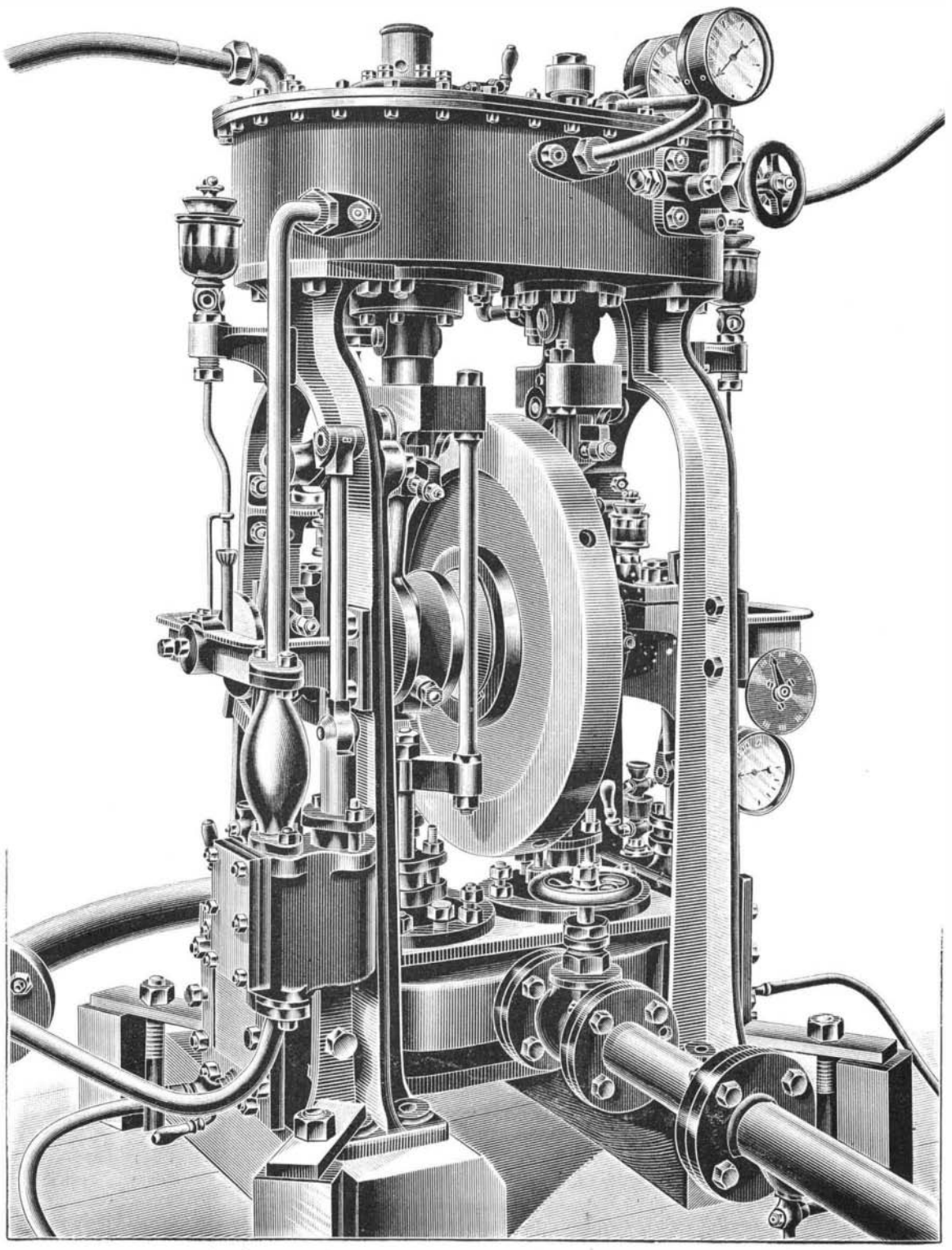
The machine consists in effect of two double-acting compressing pumps, in which the air is compressed in four stages. The capacities are so calculated that the pressures shall be equalized on each side of the pistons. The pistons are provided, it will be seen, with trunks, and the first stage raises the pressure to about 57 pounds. In the second stage this is brought up to 142 pounds, in the third to 430 pounds, and in the fourth stage to 1,430 pounds per square inch. The two compressing cylinders are cast together, with a casing or jacket to contain water, in which are placed two coils of piping. The first serves as an intermediate receiver for the first cylinder, and the second coil, connected with the small cylinder, serves to cool the air before it is delivered into the storage reservoir. The air to be compressed is drawn into the large cylinder at the top through eight valves in the cover, and kept closed by helical springs. A spray of water is introduced at the same time, while a small quantity of oil is drawn in from the lubricator on the top of this cover.

When the piston ascends it compresses the air in the cylinder. When a certain pressure has been reached valves in the piston are forced down, and the air then enters an annular space between the sides of the cylinder and the trunk. On the return stroke the air is forced into a coil. The action of the two pistons is identical. The process just described is repeated in the small cylinder. It is to be noticed that the water introduced into the first cylinder passes through all the stages and is always above the valves. It is claimed by the makers that this is a feature of much importance in machines running at a high speed, because then there is no danger of knocking a cylinder end out, or breaking a piston if too much water should chance to be admitted.

It is in reality a quadruple compression engine, the final pressure attained amounting to 1,400 pounds per square inch. The machines are made in several sizes. One to deliver 17·65 cubic feet of air per hour at the stated pressure has the following dimensions: Diameter of large air piston, 7⅜ inches; diameter of trunk, 6⅜ inches; diameter of small piston, 2⅝ inches; diameter of trunk, 1 1/10 inch; diameter of steam pistons, 6½ inches; stroke of all pistons, 4¾ inches; revolutions per minute, 300 to 350; steam pressure, 43 pounds to 71 pounds per inch. The following advantages are claimed for this system: (1) The use of a low pressure to begin with reduces the loss due to clearance; (2) the division of the work into four stages permits the air to be effectively cooled between the two cylinders; (3) the last stages of compression being effected by a very small piston, it is easy to make the piston tight, and the space over which leakage could take place is reduced to a minimum; (4) the whole machine can be taken to pieces and put together again in a very short time; (5) the delivery of the machine is independent of the pressure in the storage reservoir.

The quantity of water admitted amounts to about 15 cubic inches for every 200 cubic inches of compressed air delivered.

This compressor has been specially designed for charging torpedoes, and has, we understand, been adopted by the French naval authorities for that purpose.



IMPROVED HIGH PRESSURE AIR COMPRESSOR.

Silvester's Remedy against Dampness.

The process consists in using two washes or solutions for covering the surface of the walls—one composed of Castile soap and water and one of alum and water. The proportions are three-quarters of a pound of soap to one gallon of water and half a pound of alum to four gallons of water, both substances to be perfectly dissolved in water before being used. The walls should be perfectly clean and dry and the temperature of the air not above 50 degrees Fah. when the compositions are applied. The first, or soap, wash should be laid on when boiling hot, with a flat brush, taking care to form a froth on the brickwork. This wash should remain twenty-four hours, so as to become dry and hard before the second, or alum, wash is applied, which should be done in the same manner as the first. The temperature of this wash, when applied, may be 60 or 70 degrees Fah., and this also should remain twenty-four hours before a second coat of the soap wash is put on. These coats are to be applied alternately until the walls are made impervious to water. The alum and soap thus combined form an insoluble compound, says *Architect and Building*, filling the pores of the masonry and entirely preventing the water from entering the wall.

A Mahogany Pavement.

The dealer in hardwood who tenderly handles his stock of mahogany with kid gloves for fear of losing a splinter now and then will undoubtedly be shocked, says the *Mississippi Valley Lumberman*, to hear that mahogany is being used by the Paris Municipal Council for roadways. This sounds almost like a dream of oriental magnificence, yet it is true. A portion of the Rue Lafayette has been pulled up and workmen are laying down blocks of real Brazilian mahogany of a fine texture and color. It is, however, an experiment, as mahogany is dearer than other woods usually used for this purpose, but it is expected that the extra outlay will be more than compensated for by the greater durability of the mahogany.

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Progress of the Bell Telephone.

The Committee on Mercantile Affairs, at Boston, Mass., was recently addressed by ex-Governor Long, of that State, on behalf of the American Bell Telephone Company, which asked the privilege of increasing its present capital of $20,000,000 to $50,000,000. The address is full of interesting data relating to the telephone business, and we make the following extracts:

The telephone is the most wonderful discovery of this half of the century. No invention for that period will compare with it in magnitude, in extent and in the largeness of the business which it immediately began to do, and which hereafter it will continue to do.

At first, you will remember, it was a string with a piece of flat metal at either end. It then developed into a means of local communication, speaking from house to house or from street to street. Very soon its larger capabilities were seen, though many were doubtful with regard to its ultimate perfection or value.

In 1880, however, such was the recognition of the greatness of this discovery and of its possibilities for commercial and social benefits that application was made to the Legislature for a charter, and a charter was granted.

The Legislature recognized, even at that time, the unusual value of the invention by incorporating the company with $10,000,000 capital, which was ten times the amount allowed by the general statutes. That charter provided not merely for the incorporation of the company, but also, to a certain extent, the manner in which it should do business.

It provided that it might do it directly, or carry it on through local companies organized in this and other States throughout the Union, which were its licensees, and might take stock in such companies to the extent of 30 per cent of their capital.

These local companies cover the whole length and breadth of the United States, and the American Bell Telephone Company is doing business directly and also through those companies, its licensees.

To-day this corporation, which Massachusetts created, which is a child of the commonwealth, and which in every way has shown itself worthy of its parentage, is doing a work that embraces the whole Union, and is bringing all the people of the United States, or will soon bring them, within speaking distance of one another.

From year to year, after the incorporation of 1880, the company went on developing its connections, enlarging its plant, discovering new methods of carrying on its work, at the same time creating a demand and supplying and meeting the demand, so that in 1889 it came here again, showed what it had done with its capital, what its business was, what the prospects for the future were, and asked for an increase.

In response, its capital was doubled, making the capital $20,000,000.

On the first day of January, 1885, the company, in itself and through its licensees, had expended the sum of $31,000,000. That amount had been expended for materials and for labor; a great corporation had been made subject to your taxation, and was aiding in what is the real solution of the great present question of political economy—the distribution of the wealth of the world.

Since January 1, 1885, this company, through itself and its licensees, has expended $14,500,000 in the one item of subways and the cables contained in them, over $10,000,000 for subways or conduits underground, and over $4,000,000 for cables; that is, these great wires, which are woven together and run underground. Let me ask your attention one moment to this matter of subways.

It was early found that there might be some intricacy of wires. You have wires for street cars and wires for electric lighting in addition to these wires for telephones.

To-day you are considering the question of putting all wires underground. Let me remind you that the Bell Telephone Company, without legislative suggestion, without compulsion from the Legislature, but carrying its original and constant purpose of an honest, true development, itself initiated the system of subways. It has spent since January 1, 1885, $14,500,000 in that one item, in addition to all previous expenditures.

Next, a subway running through a great city terminates somewhere. It comes up to the top of the ground. It must enter a building. You can see at once that it is desirable that the company should not have their subway, which had been constructed at this enormous expense, come up in a building which they rent, which belongs to some one else, and which they may have to part with.

Therefore, in the development of this great enterprise, it was soon apparent that it is necessary for the company to own their buildings. They have erected them in the various cities.

They have one in Boston, on Milk Street, on which they are paying taxes. It cost nearly $1,000,000. They have erected buildings in New York and in other cities.

In the one item of real estate, since January 1, 1885, they have expended $5,884,400—call it $6,000,000, which is probably the sum to-day. Thus $6,000,000 more has gone into real estate, and the most substantial kind of property.

That money has been expended in materials and labor, and has gone into the great work of the distribution of the wealth of the world.

Next is the aerial equipment and exchange. The wires are not all underground and cannot all be underground. Part of the work is still above ground. In the matter of overhead or aerial equipment and exchange there has been expended since January 1, 1885, $12,349,000—call it $12,500,000, for it is probably that by this time, as the work is going on continually.

Now you come to what is, perhaps, the most interesting and the most important part of the work and development of this invention, the one which strikes the imagination with the most force, and that is the development of the long distance telephone. The long distance telephone runs wide over the country, and is entirely controlled and paid for by the American Bell.

It was a somewhat hazardous experiment, but just as soon as we began to talk from here to Lowell, and from here to Worcester, somebody said, "Why not talk to New York?"

The effort was made, and the line was established to that city, first working imperfectly, to-day working so well that you can talk with a man in New York as I talk to you across this table. Then came the line to Philadelphia and other cities.

Then came the desire at once to reach what is nowadays the center of the universe, and that is Chicago. It required some courage and some faith (I ask you to bear that in mind) to start that enterprise, and to ask people to put their money into the attempt to establish talking with Chicago and at such long distances. But the attempt was made, and to-day there is a perfect system of telephonic communication with that city.

What does that mean? It means 1,200 miles of copper wire from New York to Chicago. This wire is copper, one-sixth of an inch in diameter, weighing 435 pounds to the mile. One circuit to Chicago—that is, a wire there and back—takes 1,044,000 pounds of copper wire.

This long distance system is still, of course, in its early infancy. It has been established for only two or three years. I cannot give yon the exact date, but it is of very brief establishment.

There have already been put into it and other toll lines an expenditure of $10,000,000.

When anybody says, "I can buy a telephone for $2," let me suggest this to you: When you put that telephone to your ear, you are holding in your hand not merely a little piece of wood worth $2, but you are holding in your hand and are in touch with millions of dollars of property for which honest money has been paid, which furnishes the foundation for additional taxation, and which has aided in the distribution of the world's wealth by the purchase of material and the employment of labor.

Stand in New York City, and you can talk with a man in Boston to the east, in Chicago or Milwaukee to the west, in Buffalo to the north, in Washington to the south. In other words, you are covering by the sound of your voice an area which contains half the people of the United States.

Consider what that means, and what the nature of the enterprise is which puts half the people of the United States in speech with one another.

Of course, the long distance system must be extended, and preparations are already made toward extending it. You must extend to Kansas City. You must extend to Omaha. You must ultimately reach San Francisco. You must go down largely into these developing Southern States, cities like Atlanta and Galveston and New Orleans, and still farther east and still farther north.

Foot up these sums. Since January 1, 1885, there has been spent in hard cash, for real estate—I will give round figures—$6,000,000; overhead equipment and exchange, $12,500,000; underground subway, conduits and cables in them, $14,500,000; long distance and toll lines, $10,000,000. These make something like $43,000,000 which has been spent since 1885.

Add the $31,000,000 spent before 1885 and you have an expenditure in the neighborhood of $75,000,000 to which the commonwealth has never been asked to contribute a penny.

The company stands committed to the expenditure right away of $10,000,000 more to perfect its existing plans in the long distance line, to say nothing of further needs.

As I say, there must be an immediate extension of the system still farther west and still farther south, to the great cities of the neighboring country.

Let me give you one or two illustrations of our growth.

For instance, in 1881, the year after the first charter was granted, the number of miles of wire in use for telephonic purposes on January 1 was 29,714; on January 1, 1894, it was 488,521, more than fifteen times as large. Is that the end? Ask yourself. Is that all, or is more going to be expended?

Take the number of miles of underground wire. That did not begin until 1885. Without legislative compulsion, of its own motion, the company then began to establish subways, and on January 1, 1885, there were in use 1,225 miles of underground wire; on January 1, 1894, 115,000. In other words, about a quarter of all the miles of wire have been put underground since 1885.

Is that work going to stop? Is that the end of it, or is it going on? If it is going on, is not money necessary?

Take the number of telephones in use. Starting with 5,000, to-day there are 566,491—more than one hundred times as many. Is that going to stop?

How many people are supplied with telephones, numerous as they are to-day, valuable as they are in performing the business of your office? Is this use going to stop, or is it going on, going to increase?

If it is going to increase, is not more capital necessary? If it is, and it is a good business which is developed, shall the company have the capital, or shall they be told they cannot have it, and if they want more capital they must either shut up shop or go to some State that will let them have it.

Take the number of telephone subscribers. In 1881, the year after the incorporation of the company, 47,800; to-day, 237,000.

Another interesting table is this—the number of talks. It is interesting for you to know how far people are using the telephone as a means of communication with one another. In 1884 there were 215,000,000 talks over the telephone. In 1893 there were 600,000,000 talks; in 1894, 650,000,000. That is nearly 2,000,000 talks a day. One has to stop and deliberate to get into his mind such a sum.

How many messages are sent over the telegraph lines? My memory is that there are about 63,000,000, and the telegraph has been developed a great many years. On the other hand, telephone communication is in its infancy, and yet your telegraphic messages during the year are 60,000,000, while your telephonic messages are 650,000,000.

To subscribers, that has amounted to from 2 to 11 cents for each message. You pay 30 cents for a talk, say, to and from Haverhill or Worcester, or even $2 from here to New York; but to telephonic subscribers the average has amounted, on the average, to from 2 to 11 cents for each talk. And you are not limited to ten words.

You have two or three minutes' talk, and you know how much you can do in a very few minutes, unless you are unfortunate enough to be addressing a committee and taking more time than you ought. In other words, the cost is reduced toward the cost of the United States mail.

The number of persons employed will interest you; that has increased, so that to-day there are over 10,000 persons employed.

At the building where we shall go in a few minutes, I desire to show not only the beginning of the subway and these enormous cables, but to call your attention to some details which are suggestive of the magnitude of the whole thing.

Take, for instance, the switchboard. In the city of New York, one switchboard is 264 feet long, at which sit the operators. Each operator attends to perhaps 50 subscribers. There are 10,000 subscribers in the city of New York. Any one of them, by ringing his bell and calling up the central office, can be put into communication with the other 10,000.

Gentlemen, think for one moment what this system already enables us to do. You will hear, as you hear with regard to other enterprises—I think less here than usual—complaint as to some little detail here or there; but is there, do you feel, do you know, that there is in the community any real or general restiveness under the existence of the telephone company?

Is it not recognized as a great, a very great invention, and a matter of inestimable commercial and business convenience and value? You can communicate with any part of the city, with any part of the State, and soon with any part of the United States.

You send for your doctor and communicate with your lawyer. You communicate with your business partner. Your wife orders her groceries and talks with her friends.

A man will growl, perhaps, because he has to pay twenty-five cents for a telegraphic message, because he has to pay twenty-five cents for a telephonic message, or whatever the sum may be; and yet, ask him whether it is not of advantage that, staying in his home thirty or forty miles away, he has been able to communicate with Boston and perform an important piece of business, and thus save the expense of travel and the loss of a day's time, and he will answer at once that the advantage is worth everything to him.

Who are the stockholders of this company? There are 200,000 shares of stock. There are 5,277 stockholders, and of these 3,721 are stockholders who have holdings of less than 25 shares each; in other words, three-quarters of the stockholders in this great company have less than 25 shares each.

We are asking the State to do something for its own

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advantage. The corporation is paying into the State treasury $150,000 a year in the way of taxes.

We ask you to retain this corporation in Massachusetts, that its headquarters shall be here, that its employment of a clerical force and of operatives shall be here, so that Massachusetts shall get the benefit of having its citizens employed, its supplies furnished from Massachusetts sources.

The Brilliance of a Candle Flame.

That the luminosity of a candle can be calculated direct from the dimensions of its flame is the rather striking theorem of Herr P. Glan, who gives the results of his measurements in the current number of *Wiedemann's Annalen*. The volumes of the bright portions of various candle flames were measured by taking the length by means of a scale placed behind the flame, and the breadth at various points by gauging it with calipers or compasses. These bright portions have approximately the shape of cones, each of these cones being penetrated from below by a truncated cone, consisting of the dark central portion. The difference between the volumes of the two cones gave the volume of the brilliant portion. Stearine and paraffin candles of various thicknesses, and provided with different wicks, were compared by means of a rod photometer. It was soon found that the height of the flame was not the only factor determining the brightness. A stearine candle of 5·88 cm. circumference had, on the other hand, a higher luminosity than another 6·49 cm. in circumference. But a determination of the ratio of the volume to the illuminating power showed that this ratio is very nearly constant, the difference between the actual luminosity and that calculated from its volume never exceeding 3 per cent. In other words, equal volumes of the bright flame of any two candles give out the same amount of light.

Soap Suds for Calming Waves.

The remarkable action of oil upon waves is well known. This phenomenon led the officers of the steamship Scandia, of Hamburg, to make an experiment upon the same principle that was very successful, and that appears to us worthy of mention. During its last trip to the United States the vessel, while in mid-ocean, was attacked by a very heavy storm. It then occurred to the officers to dissolve a large quantity of soap in tubs of water. Having thus obtained several hundred gallons of soap suds in a very short time, they threw it overboard in front of the ship. The effect was almost instantaneous, and the vessel soon began to navigate without difficulty. Her officers at once addressed a long report to the Hydrographic Bureau of the United States, giving an account of their voyage, the storm, and the means that they employed to still the waves. They conclude by saying that although soap suds does not produce absolutely all the effects upon water that oil does, it at least suffices to break the force of waves in most cases. Besides, this method recommends itself to transportation companies careful of their interests. Soap suds is much cheaper than oil, and a relatively large quantity of soap can be carried without encroaching too much upon the space set apart for passengers and merchandise.—*La Nature.*

EOLIAN HARPS.

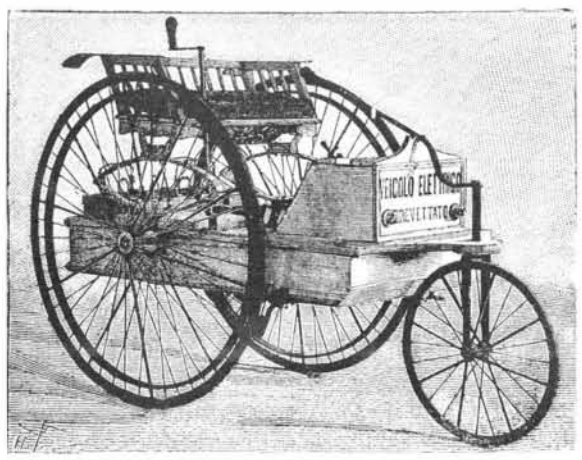
The following experiment, although performed as long ago as 1855 by Mr. Wheatstone at the Polytechnic Institution, is of sufficient interest to reproduce. Upon the center of the stage were arranged, in a semicircle, four Erard harps, which, at the pleasure of the experimenter, vibrated as if they were made to resound by invisible hands. To this effect, there had been fixed to the sounding boards of each of them four vertical rods of firwood, which descended perpendicularly, passed through the floor of the stage and the ceilings beneath, and in the deep cellar of the Institution were fixed, one of them upon the sounding board of a piano, another upon the sounding board of a violoncello, and the two others upon the sounding board of violins. In order to render it possible to interrupt the vibrations between these instruments and the harps, the rods supporting the latter had been divided at a few centimeters above the floor. A revolving motion of the harps caused either their juxtaposition with or their separation from the rod.

This thoroughly scientific experiment was taken up under the name of Eolian harps by Robert Houdin, who introduced several scenic modifications into it. A stage elevated in the very midst of the spectators was traversed by two firwood rods, which, after passing through the floor, rested upon harps placed in the hands of instrumentalists. At the command of the skillful prestidigitator, two other instruments, supported by the upper extremity of the rods, executed a concert whose success was immense, thanks to the careful and very elegant *mise en scene*. Certain operators further surprised their spectators through the pretended intervention of mediumistic spirits very much in fashion at the time.—*La Nature.*

CARLI'S ELECTRIC CARRIAGE.

The question of small automobile vehicles for streets and highways is at present the preoccupation of the manufacturers and inventors of all countries. The competition instituted by the *Petit Journal* will certainly bring to Paris all the systems that have been devised for the solution of the problem—steam, gas, petroleum, and electricity produced by batteries or stored up in accumulators. This latter solution, which to us appears to offer the brightest future for an application in large cities that are provided with central stations of distributions of electric energy, is, nevertheless, the one that answers the least to the programme drawn up by our daily contemporary, and too hasty and too absolute conclusions must not be deduced from the check that electricity will necessarily suffer.

We do not generally take a vehicle upon road ways for



CARLI'S ELECTRIC CARRIAGE.

trips of 60 miles. For such journeys the railway is the proper mode of conveyance. But we do take a coach for making excursions, and visits and doing business for a few hours, in returning sensibly to the starting point, and it is for such applications, which are the most numerous, that the use of energy stored up in accumulators comes in.

However this may be, researches in this direction continue, and we shall now make known to our readers a new electric carriage, of which a description has been kindly communicated to us by Prof. G. Milani, of the University of Pisa. The essential part of the description that he sends is as follows:

This carriage was constructed at Castelnuovo (Garfagnana) in the power loom weaving establishment of Count Joseph Carli, deputy to the Italian parliament. The Carli electric carriage is actuated by accumulators of the Verdi type, this having been selected because it possesses a great specific capacity and can best resist the shocks always inevitable in a vehicle designed to run upon all sorts of roads. The battery consists of 10 elements each having a capacity of 100 amperes-hour, say 200 watts-hour. There is thus at one's disposal 2 kilowatts-hour. The model employed weighs 11 pounds and contains five plates. Under conditions of normal discharge, the battery furnishes a current of 5 amperes, say about a half ampere per pound. The plates are arranged horizontally in a wooden cage, are held in place by small bars of ebonite and are separated from each other by a fabric of paraffined jute. The whole is inclosed in small ebonite boxes hermetically closed by an ebonite cover, in order that the liquid may not slop over through the effect of jolting. The inventors have found it of a certain advantage to have recourse to a system of very slow charging. To this effect, they employ very feeble currents of a duration of from twenty-five to thirty hours, and this permits of using primary batteries. This circumstance is favorable to the best rendering and to the best rate of discharge of these accumulators, even when the external resistances vary in a large measure. Experiments have proved that the rapid discharge presents no inconvenience and leads to no alteration of the positive surfaces. The rendering alone drops from 97 to 63 per cent, if we pass from a half to one ampere per pound of plates. The battery of 10 accumulators of the type described above confines an energy equal to 2 kilowatts-hour. The vehicle weighs but 350 pounds in running order.

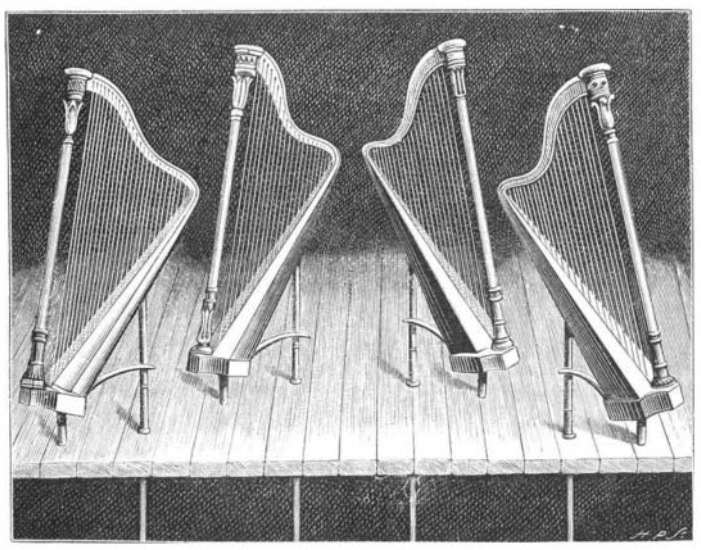
The motor actuates the hind wheels directly by means of gearings. It absorbs about 550 watts and the battery is capable of supplying it for a four or five hours' trip. The excitation is in derivation. The motor is capable of serving for the recharging of the accumulators, by virtue of the well known principle of reversibility. It is only necessary to apply a winch or a belt. There is a train of gearings between the axis of the motor and that of the wheels. By means of this gearing, it is possible, by turning a winch, to reduce the angular velocity of the motor from 1,000 revolutions per minute to 100 or to 30. On another side, a rheostat permits of varying the angular velocity of the motor from 1,000 to 300 revolutions per minute. It is thus possible to develop the greatest power corresponding to every speed, to run at slow speed upon ascending roads, at high speed upon declivities, etc.

For starting and for unforeseen obstacles on the way, recourse is had to an impulsion box that is held in reserve. This consists of a system of rubber tension springs that are stretched by revolving a small wheel, even during the running of the carriage. When an energetic impulsion is necessary, the springs are relaxed by means of the foot, and produce upon the axle an impetus equal to double the power of the motor itself, and sufficient for a run of at least 160 feet.

The Carli establishment, under the able superintendency of Mr. F. Boggio, is constructing two types of this carriage, one of them simple and cheap and the other more elegant and more elaborate in detail. It is the second type that is represented in our figure.

We have cared to publish this note in order to well show that the electric coach, such as we conceive it, is not a utopia. The electric carriage of Mr. Pouchain and that of Mr. Carli are already realizing the majority of the conditions necessary to this kind of exploitation. The questions of form will soon be solved by the art of the coach builder and that of the electrician.

A few more improvements in accumulators, and central stations will, in the charging of coach accumulators during the day and a part of the night, have an important market that will improve their annual rendering as well as their present conditions of exploitation.—*La Nature.*



EOLIAN HARP EXPERIMENT.

American Fire Arms.

Some time ago we published the statement that the German Mauser rifle was an American invention, and we are now asked as to our authority for that statement. Those familiar with the facts are aware that Mr. Mauser, at the time the weapon having his name was invented, was a skilled mechanic in the employ of the E. Remington & Sons, Ilion, N. Y., and that the first Mauser gun was constructed at the expense of the Remingtons, and under the supervision of their master mechanic. The Remingtons had an interest of one half or more in the invention, but Samuel Remington, who for many years represented the company in Europe, had such an unfortunate experience of the German government's illiberality to inventors that he sold his interest in the gun to Mr. Mauser for $500. These facts fully justify our statement, referred to, that the Mauser is an American invention. The Lee rifle was also invented and constructed originally at Ilion, and it furnishes the essential idea of most if not all of the rifles now in use in European arms, with the exception of the improved Chassepot or Gros. It certainly excites surprise in the mind of any one who is familiar with the history of small arm invention to find our government going abroad for its service weapon. The kingdom of Sweden and Norway, from one of whose subjects we obtain our new army rifle, was the first foreign government to adopt and purchase an American breech-loader, the Remington. With proper encouragement from the government our small arms manufacturer might hold the field against the world. The design and essential idea of the breech-loader and magazine gun, wherever it is found, is American. The machinery used in the manufacture of modern arms in all foreign countries manufacturing their own arms is of American invention and in large measure of American manufacture. The machinery in the armories of Germany was manufactured by the Pratt & Whitney Co., of Hartford, Conn., and the German workmen were instructed in its use by Yankee mechanics, sent out by that company and remaining in Germany for one or more years.—*Army and Navy Journal.*

THE farmer in Japan who has ten acres of land is looked upon as a monopolist.

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RECENTLY PATENTED INVENTIONS.

Engineering.

VALVE OPERATING MECHANISM.—Jacob J. Moore, Chambersburg, Pa. This inventor has designed novel means whereby the engine may be reversed or throttled by the use of a single lever and eccentric. The construction is such that when the lever is adjusted to its central position the eccentric will be adjusted to set the valve to shut off steam, and if the lever be moved either forward or back it will so throw the eccentric as to move the valve to open the port to admit steam to one or the other side of the piston to properly move it, to drive the engine forward or back. Duplicate eccentrics, one for each side, will be needed in locomotives.

Railway Appliances.

CAR COUPLING.—Edward J. Lahan, Quincy, Ill. In this coupler the drawhead has the usual flaring mouth, but with its sides, top and bottom, solid, whereby the interior coupling members are protected from the weather and the head rendered more stable and compact. The coupling is effected by means of a gravity latch, working automatically when the drawheads come together, obviating the need of going between the cars, and the uncoupling may be effected from either the sides or the bottom of the cars. The device is extremely simple and inexpensive.

SWITCH LOCK.—Samuel E. Bartlett, Red Bank, N. J. This invention relates to interlocking switch systems for railroads, where the switch, signal, and switch lock are all operated from a tower. The new device consists of a switch or bolt under the control of the operator and adapted to engage the switch bar to lock the same in position by an ingenious system of sliding plates which are engaged by the bolt. By this mechanism the operator is prevented from locking the switch unless it is in its proper position, and he cannot display the proper signal controlling such switch unless it is properly set and properly locked.

FLANGER.—Thomas W. Macfarlane, of Ellensburg, Washington. This invention consists of a novel device for removing snow and ice from the rails of railway tracks, and is especially adapted to remove the snow and ice usually left by the snow plow on the tops and sides of the track rails. The flanger is secured directly to the truck, and the cutter, with its attachments as the apron which throws the loosened ice and snow to one side, is operated with a piston rod connected with a cylinder attached to a suitable air or steam supply. A coiled spring returns the mechanism to the normal position when the air or steam pressure is removed.

UNDERGROUND RAILWAY CONDUITS.—Wilton F. Jenkins, Richmond, Va. This invention consists of a cylindrical tube or conduit the edges of which are formed in a peculiar manner at each side of the slot to give the requisite thickness to resist the weight of traffic in the street. Yokes pass under the conduit tube and secure the rails, thus obviating the use of bolts or rivets to fasten the rail. This connection between the rail and the yoke is a universal one and enables the rail to be grasped at any point without cutting holes in the rail or yoke. By the construction of the overhanging walls and stiffening web a vertical distance from the top of the slot rail to the outer periphery of the cylinder is secured so as to allow blocks of paving material to be laid in sufficient vertical depth close up to the slot rail so as to secure a substantial finish.

CONDUIT ELECTRIC RAILWAY.—Wilton F. Jenkins, Richmond, Va. This simple and effective device cousists of a conduit tube provided with two horizontally projecting arms carefully insulated and bent to receive the two conducting wires which are laid loosely in a recess provided for them. A hook-shaped trolley is provided for each conductor which raises the wire from the support and is provided with a wiping attachment or pad which cleans the supporting arm at each passage of the trolley.

ELECTRICALLY OPERATED RAILWAY SWITCH.—William S. Gavey, Brooklyn, N. Y. This switching device is intended to be operated from a moving electric or other car. By an ingenious system the switch may be automatically operated by a moving car so as to be thrown before the car reaches it and to be thrown back after the car has passed, also to provide a switch system adapted to railways having numerous sidings so that each car will turn its particular switch, but pass over the other switches without affecting them. The switching is done by electro-magnets, the current being obtained from an overhead trolley wire with the aid of a contact pulley.

Miscellaneous.

AMALGAMATOR.—Nathan Leroy Raber, Corvallis, Oregon. This invention consists of cells, which receive the agents by the electrolysis of which the mercury may be cleaned or purified, and a lead or similar conductor extended longitudinally within the cell whereby an electrical discharge from end to end of the cell is secured. Various other devices for regulating the supply of the quickening agent, the mercury, etc., are provided. By the construction and arrangement of the several parts of the amalgamator the whole surface of the mercury at the point of contact with the thin stream of pulp is kept perpetually clean and active.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

A TEXT BOOK OF MECHANICAL DRAWING. Part III. Machine Drawing. By Gardner C. Anthony, A.M. Tufts College, Massachusetts: Published by the author. Pp. 50, 16 plates. Cloth. Price $1.80.

This is an excellent work. The treatise is intended to teach the practical application of the principles of projection to the illustration of machinery, and to furnish such practical examples as may serve for problems to the student and suggestions to the draughtsman. It is really refreshing to see a book on mechanical drawing which gives the proper amount of lettering and dimensions. The plates, with a few exceptions, are arranged so that they are visible while the text is being read; this is the proper way of inserting plates and maps, but is unfortunately a rarity. The whole work bears the stamp of being made by a thoroughly competent and conscientious draughtsman.

THE TINSMITHS' PATTERN MANUAL. Patterns for tinsmiths' work. By Joe K. Little. Chicago: The *American Artisan* Press. 1894. Pp. ix, 248. Price $1.

This work treats in great detail of the development of tinsmith's articles for the purpose of cutting out the pieces therefor from the flat metal. This it does elaborately, its purpose, evidently carried out, being to lay down general geometrical principles by which work other than that described in the book may be done. The text consists of a series of problems well illustrated, and an excellent index, with both page and paragraph references, is a feature worthy of being noted.

DAVID OF JUNIPER GULCH. A story of the placer regions of California. By Lillian Shuey, author of "California Sunshine," etc. Chicago: Laird & Lee. Pp. 413. Price $1.

CRIME AND PUNISHMENT: A NOVEL. By Fedor Dostoieffsky. Translated from the original Russian by Frederick Whishaw. Chicago: Laird & Lee. Pp. 456. Price 50 cents.

THE EGYPTIAN HARP GIRL: A MYSTERY OF THE PERISTYLE. By "Quondam." Illustrated. Chicago: Laird & Lee. 1894. Pp. 292. Price $1.

PAUL WEISS. Ingenieur au Corps des Mines. Le Cuivre. Avec 96 figures intercalées dans le texte. Paris: Librairie J.-B. Bailliere et Fils. 1894. Tous droits reserves. Pp. viii, 344. Price $1.

SCIENTIFIC AMERICAN BUILDING EDITION.

APRIL, 1894.—(No. 102.)

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1. Elegant plate in colors showing a handsome colonial residence just completed at Ashbourne, Pa, for Charles Salmon, Esq. Two perspective views and floor plans. Cost complete $11,500. Frank R. Watson, Esq., Philadelphia, Pa., architect. An elegant design.
2. Plate in colors of a Chicago dwelling designed for an architect's home, and recently completed at Morgan Park, Chicago, Ill. Two perspective views and floor plans. Cost $4,200 complete. Mr. H. H. Waterman, architect, Chicago, Ill.
3. Two perspective views, interior view and floor plans of the elegant residence of Judge Horace Russell recently completed at Southampton, Long Island. Mr. Bruce Price, New York City, architect. An admirable design in the colonial style of architecture.
4. An English cottage at Buena Park, Chicago, Ill. Two perspective views and floor plans. Mr. James Gamble Rogers, Chicago, Ill., architect. A unique design in the Gothic style of architecture.
5. A residence at Southport, Conn. Two perspective views and floor plans. A picturesque design in the modern colonial style of architecture. Mr. W. W. Kent, New York City, architect.
6. A cottage at Freeport, Long Island, erected at a cost of $2,600 complete. Perspective view and floor plan. A unique design. Mr. W. Raynor, Freeport, L. I., architect.
7. A residence at Rogers Park, Ill. Two perspective views and floor plans. Cost $3,948 complete. An attractive design. Mr. C. W. Melin, Chicago, Ill., architect.
8. Two perspective views and floor plans of a dwelling rently erected at Rogers Park, Ill., at a cost of $3,730 complete. A unique design. Mr. Robert Rae, Jr., Chicago, Ill., architect.
9. A cottage at Morgan Park, Ill., erected at a cost of $2,968 complete. Two perspective views and floor plans. An attractive design, treated in the English cottage style of architecture. Mr. H. H. Waterman, Chicago, Ill., architect.
10. The new St. James M. E. Church at Kingston, N. Y. Perspective and plans. Architects, Messrs. Weary & Kramer, of New York City and Akron, Ohio. Estimated cost, $70,000. Style of architecture, Romanesque.
11. Miscellaneous Contents: Vibrations of tall buildings.—Artificial stone.—A simple and efficient dumb-waiter, illustrated.—An improved woodworking machine, illustrated.—The New Era electrical gas burner, illustrated.—P. & B. Ruberoid roofing, sheathing papers, and paints.—Improved woodworking machine, illustrated.—Foot power mortising machine, illustrated.—A large sheet metal ceiling, illustrated.

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Emerson, Smith & Co., Ltd., Beaver Falls, Pa., will send Sawyer's Hand Book on Circulars and Band Saws free to any address.

Split Pulleys at Low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Patent for Sale—Stall for comfort and cleanliness of milk cattle. Agents wanted at 50 per cent commission. M. Schembri, 396 Van Buren St., St. Paul, Minn.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

Patent Electric Vise. What is claimed, is time saving. No turning of handle to bring jaws to the work, simply one sliding movement. Capital Mach. Tool Co., Auburn, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(5958) T. R. B. asks: Will you please state in your answer to my inquiries of 24th what is the best size of wire to use for telephone lines? A. No. 12 galvanized iron or steel wire is generally used for telephone lines.

(5959) F. J. M. writes: Referring to article on "Wind Pressure," in SCIENTIFIC AMERICAN SUPPLEMENT, No. 950. 1. Why should the wind pressure against one side of a cube be less than upon a thin plate of same size? A. In the thin plate there is a vortex formed at the back of the plate which prevents reaction, while in a thicker body, like the cube, the vortical space is filled by a solid, allowing the displaced air time to return behind the cube and counteract the vortex made by the outward flow of air at the front edge. The same effect is observed under the same conditions in the movement of plates and solids through water. 2. Why should the wind pressure acting upon a hemispherical cup, when its convexity is turned toward the wind, be greater than upon a flat plate of equal diameter? A. The wind pressure is less when the convexity is turned to the wind than when a plane surface or concave one is turned to it. Convexity is a mistake in your question. It should be concavity.

(5960) B. writes: 1. I would like to get some data concerning the small vanes in exhausted bulbs which are caused to revolve by the action of the light. I think they are known as "Crookes' mill." What is the minimum intensity of light at which they will revolve? A. It will revolve in the dark, provided there is heat. Its action does not depend on light. 2. Suppose a 16 candle power lamp were placed at a distance of 6 inches from the vanes, what would be the approximate number of revolutions? A. A 16 candle power lamp at a distance of 6 inches will revolve the vanes quite rapidly, but the velocity varies with radiometers of different forms. 3. Are they for sale, and at what price? A. Radiometers are for sale by most dealers in physical instruments. The price is from $3 to $5. 4. Has a description of them ever appeared in the SCIENTIFIC AMERICAN, and if so, in what number? A. For information on Crookes' radiometer, we refer you to SUPPLEMENT, Nos. 13 and 26. Price by mail 10 cents each.

(5961) W. S. R. asks: 1. Please tell me how to make a Gramme ring motor. A. You will find a full description of a small Gramme ring motor in SUPPLEMENT 641. 2. Also how to make a two or three horse power water wheel for a brook with a fall of 12 inches and a force of 20 barrels per minute. A. SUPPLEMENTS 61, 380, and 704 contain descriptions of turbines for various uses. You can probably get the information you desire from these articles. 3. Is the —— Piano Company a reliable firm? A. We do not furnish information of this character. 4. How can I make a galvanic bichromate battery to run 641 motor? A. For instructions for making bichromate battery, we refer you to SUPPLEMENT 792. 5. Is there any way to make a boiler to run a one horse power engine? If so, how can I make it and where can I get the material? A. For directions for making small boilers, see article on the subject contained in SUPPLEMENT 702.

(5962) B. S. L. asks: 1. Why, when a person looks at an object through the large end of an opera glass, the object appears smaller and at a great distance? A. The reversal of the glasses produces the effect, the negative lens being then in front of the magnifying lens. 2. Will No. 21 double-covered copper wire give just as good results on the armature of eight-light dynamo, SUPPLEMENT 600, as single-covered No. 20, and thus insure better insulation? And will not an addition of more wire on field magnets give a stronger current? Also is the sheet iron disk armature core to be preferred to the wire core? A. Double-covered copper is probably to be recommended for the purpose named. The E. M. F. will be a little greater and the current will be a little less. There are certain ratios of resistance between armature and field which are not advantageous. 3. Is it practical for an amateur to attempt the construction of a gas engine, and can you give me the address of a firm where gas engine castings are made? A. A gas engine is very troublesome to build. You might address gas engine manufacturers who advertise in our columns; but we doubt if any of them would furnish castings. 4. What are the dimensions of coil and size of wire used on a coil to produce a spark one inch in length? A. Exact dimensions of the induction coil asked for cannot be given. Consult SUPPLEMENT 160 for information in regard to a coil giving 1½ inch spark. This can be regulated to produce a 1 inch spark. 5. The formula for a good leather cement, also a good rubber cement. A. An India rubber cement is made of: 15 grains of India rubber, 2 ounces of chloroform, 4 drachms of mastic; first mix the India rubber and chloroform together, and when dissolved the mastic is added in powder. It is then allowed to stand for a week or two before using. Leather and Pasteboard, Cement for.—Strong glue, 50 parts, is dissolved with a little turpentine in q. s. water, over a gentle fire; to the mixture is added a thin paste, made with 100 parts of starch. It is applied cold, and dries rapidly.

(5963) B. T. writes: 1. We evaporate from 2,100 to 2,300 gallons of water per hour in our boilers. What should be the dimensions of such a boiler or boilers to do that amount of work with some degree of economy? A. The evaporative power of a boiler is approximately given by the formula $1{\cdot}833\left(\frac{S}{28+F}\right)e =$ pounds of water per pound of fuel, in which S is the heating surface and F the pounds of fuel, and e the evaporative power of the fuel. Taking $e=15$ we have $10{\cdot}448$ pounds water per pound of coal. Taking this as representing your case, you will need a boiler to burn 230 pounds of coal per hour, or about 20 square feet of grate or natural draught, and a heating surface of 200 to 300 square feet. Conventional horse power of a boiler is not reliable. 2. What is the market value of mercury per pound? A. About 75 cents a pound. 3. What is the weight of one cubic foot of mercury? A. 846 pounds at 60° Fah. 4. At what temperature will mercury start to evaporate? A. It evaporates slowly at ordinary temperatures. It boils at 675° Fah. 5. Will mercury dissolve in alcohol, ether, or any other oil or grease? A. No. 6. If mercury be put in iron vessel, will it attack the iron? A. No. 7. If mercury be heated to 200 or 250 degrees, will it give off any gas or fumes so as to endanger the person handling the same? A. It will slowly produce bad effects; the practice is an unsanitary one. 8. Have you a good book on modern boilers? A. We can supply you with the following books: "A Manual of Steam Boilers," by Thurston, price $5 by mail; also "Steam Boilers," by Rose, price $2.50.

(5964) W. B. J. says: Can you inform me through your valuable paper how to mark fine steel tools with acid, using a rubber stamp? A. Have a plain border round the design, large enough to allow a little border of common putty to be laid around the edge of the stamped design, to receive the acid. For ink, use resin, lard oil, turpentine, and lampblack. To ¼ pound of resin put 1 teaspoonful lard oil; melt, and stir in a tablespoonful of lampblack; thoroughly mix, and add enough turpentine to make it of the consistency of printer's ink when cold. Use this on the stamp in the same manner as when stamping with ink. When the plate is stamped, place a little border of common putty around and on the edge of the stamped ground. Then pour within the border enough acid mixture to cover the figure, and let stand a few moments, according to the depth required, then pour the acid off. Rinse the surface with clean water, take off the putty border, and clean off the ink with turpentine. Use care not to spill the acid over the polished part of the article. For the acid, 1 part nitric acid, 1 part hydrochloric acid, to 10 parts water by measure. If the effervescence seems too active, add more water. 2. How are knife blades marked that have names on them? A. Knife blades are sometimes marked in this way, but generally the brand is placed on knives, etc., when they are in a heated condition by a steel stamp. 3. Can cast iron be plated with aluminum? If so, how can I do it? A. Yes; copper the iron, then deposit the aluminum, using the following formula: Fifty parts by weight of alum are dissolved in 300 of water and to this is added 10 parts of aluminum chloride. The solution is heated to 200° Fah., and when cold 39 parts of cyanide of potassium are added. A feeble current should be used.

(5965) F. L. asks: 1. Are all alternating generators excited by a separate direct current machine? A. No. Sometimes they are self-exciting, having a commutator in addition to the collecting rings. 2. Is an alternating current ever used for arc lights or for exciting the fields of a dynamo? A. It is often used for arc lighting, not for exciting dynamo fields. 3. Will the current alone be cut down by increasing the resistance of a coil or line, or will the voltage also be affected? A. Increasing the resistance of the circuit will tend to increase the potential at the terminals. 4. Is the earth's attraction greater at a high elevation than at sea level? A. No; it is less. 5. How is the displacement or tonnage of a vessel or ship computed? A. By various rules, some arbitrary and some based on approximate calculation of the immersed volume of the ship. 6. How do the supposed spiritualists and magicians perform the trick of lift-

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ing up a chair or small table by simply placing the hands upon them? A. Sometimes a ring is worn which has a slot in it. A pin is driven into the chair or table. The performer catches the pin in the slot and so lifts the table.

(5966) I. R. asks: 1. Can a storage battery be charged off an alternating circuit of 50 volts? A. It cannot be so charged. 2. What is the difference between the make-up and winding of an alternating and continuous current motor? A. We must refer you to our SUPPLEMENTS which illustrate the same. They are quite different. 3. How many storage batteries will it take to run a Stanley fan motor (made by the Electric Supply Co., Chicago) 10 hours daily? A. Two or three if the motor is wound for them. Otherwise, many more may be needed. 4. Can a 2,000 volt arc continuous circuit be tapped in such a way as to get a current of 50 volts, and not be able to hinder the lights nor short-circuit the wires in any way? A. It can be done by putting in a shunt of forty times the resistance of the line included between its connections thereto. It will if used tend to interfere with the service and will be very dangerous to admit into a house. We advise you not to attempt it.

(5967) A. W. S. asks: 1. How much wire and what size will be required to wind a 60 ohm telegraph sounder? A. 903 feet of No. 28, which requires 2066·116 feet for a pound of wire of this size; or if you prefer, you can can wind with 568 feet No. 30, 3,111 feet to the pound. 2. Also for an instrument of 150 ohms resistance? A. 893 feet of No. 32. Of this 5963 feet are required for one pound. 3. What is the advantage of silk-covered wire over cotton-covered for this purpose? A. Silk makes a better insulator and takes up less room. 4. Can you recommend any book which treats on telegraphy? A. We recommend "Modern Practice of Electric Telegraph," by F. L. Pope, price by mail $1.50; "Hand Book of Telegraphy," by T. D. Lockwood, price $2.50.

(5968) B. B. M. asks: 1. Will a storage battery of 4 cells, each cell composed of 8 plates, 1½×3 and 1-16 inch thick, be sufficient to run a 2 candle power incandescent lamp for several hours at a charging? A. No. The plates are too small. 2. Is there any good metal of which the containing jars of a storage battery could be made, and which would not be attacked by the solution? A. Lead will answer. 3. Which is the best method for making the plates of a storage battery? To merely roughen the plates, and allow the lead oxide to be formed by repeatedly charging and discharging in opposite directions, or to coat all the plates with red lead, or to coat the positive plates with red lead and the negative plates with litharge. A. This is a very open question. For amateur's use probably the roughened plate, treated with nitric acid, and then formed, is probably the best. In commerce pasted or porous plates are almost universal in this country.

(5969) J. G. says: Could you inform me what is used by laundrymen to bleach clothes, besides javelle water, and a so what they use to remove fruit stains from clothes? A. Make a strong solution of chloride of lime (hypochlorite of lime—bleaching powder) in water, allow to settle, and draw off the clear liquid. Rinse the goods in clean water containing about 5 per cent of sulphuric acid, and then pass them slowly through the bleaching solution. They should then be well rinsed in water containing a little carbonate of soda. If the cloth is much colored, it may be necessary to allow it to remain for a short time in the bath. This is the usual method of bleaching in laundries. 2. To remove fruit and wine stains from table linen, moisten with dilute sulphuric acid and then rub with aqueous solution of sulphite or hyposulphite of soda in water, or spr ad the stained part over a bowl or basin, and pour boiling water through it. or rub on salts of lemon and pour boiling water through until the stain disappears or becomes very faint.

(5970) J. H. B. says: Can you tell me how a soft solder can be made so that it can be used without acid? I want one that can be run into sticks and used with a slight heat. A. Melt together in a crucible, at a very moderate heat, bismuth, 1 part; tin, 3 parts by weight; lead, 2 parts; and cast in slender sticks. You will need acid or some flux however. No solder is made that will work without, except on very clean surfaces.

(5971) M. L. writes: Is the hypothetical ether supposed to be rigid or not? Can it be matter and be imponderable also? If it occupies space between the molecules, say of glass, and vibrates freely among them, must not the molecules of ether be very much smaller than those of glass, and will the molecular theory of matter admit of this condition? Why does glass transmit light, and wood not? Are there any other theories of light, heat, and sound propagation besides the ether wave and air wave theories? A. The ether is very imperfectly described, and cannot have the attributes defined as in the case of perceptible matter. It is not matter in the everyday sense, and is not subject to the molecular laws of matter. No reason can be given for transparency except that certain bodies seem to exclude ether from the space they occupy. Wood however is not transparent, from multiple reflection largely. Other theories have been advanced, but are rather more unsatisfactory.

(5972) E. H. E. asks: What was the composition of the mixture called "staff," used in the modeling of the statuary and in the construction of the World's Fair Buildings at Chicago? A. Staff is composed of plaster of Paris, alumina, Portland cement, mixed with glycerine, dextrine, and water; coarse bagging or New Zealand hemp is used to give strength. The composition varies according to the particular kind of work to be done. See the SCIENTIFIC AMERICAN for August 8, 1891, and March 18, 1893.

(5973) Constant Reader asks: What is the color and general appearance of aluminum as found in the raw clay, and is it visible to the naked eye? Also, what is the cheapest price that it has been marketed for? Are there any chances for a person to-day to try and discover a means by which to lessen the expense of the so-called metal? A. Aluminum is not found in the metallic state. It cannot therefore be discerned in clay. The lowest price is about 50 cents per pound. There is a possibility of course of reducing the cost of extraction.

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April 10, 1894,

AND EACH BEARING THAT DATE.

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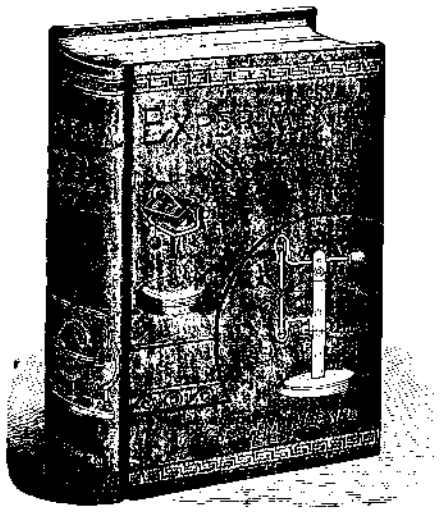

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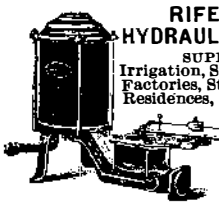

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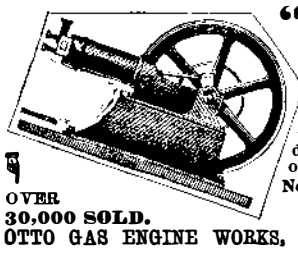

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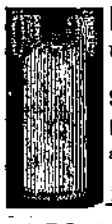

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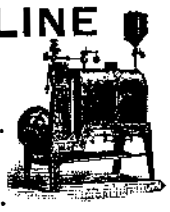

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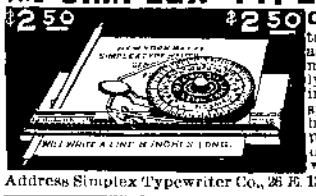

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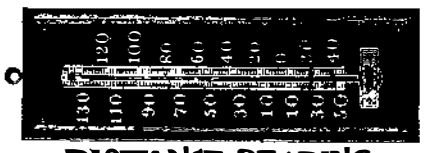

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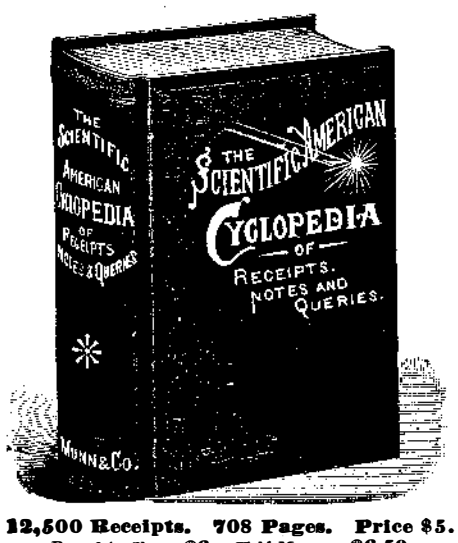

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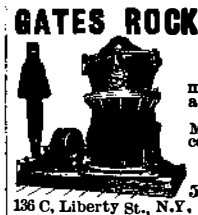

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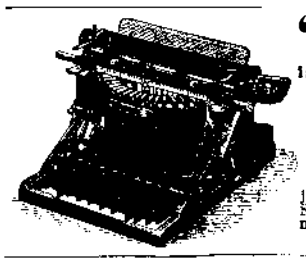

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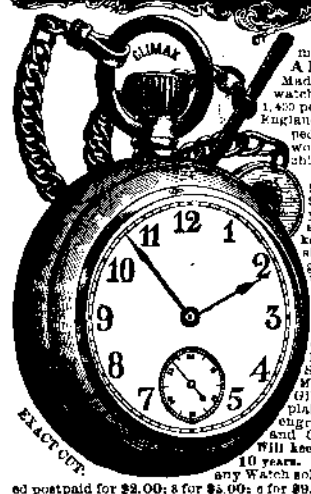

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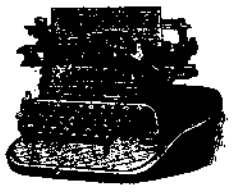

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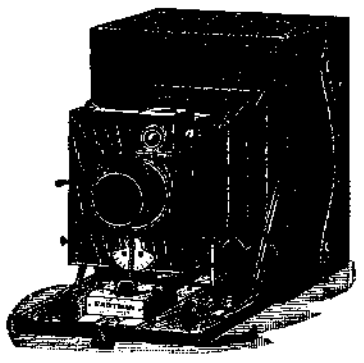

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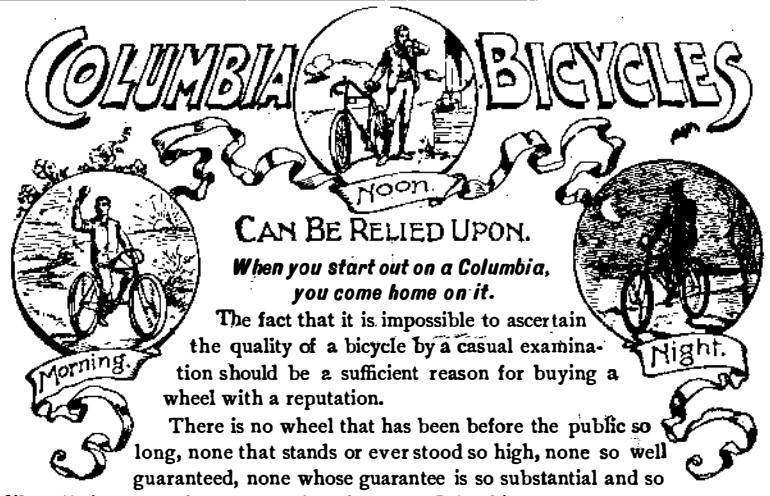

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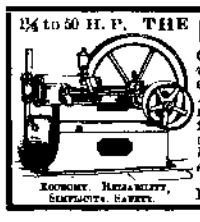

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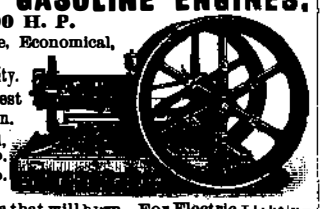

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